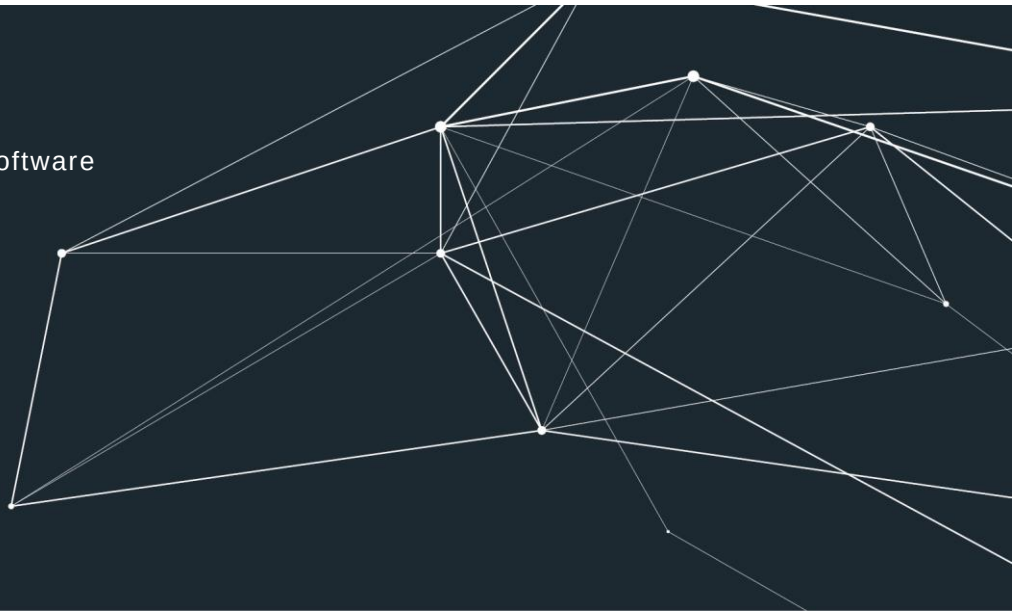
Software Specification

FrameWorkx Video Processing Software



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Contents

Figures

Revision History

Revision	Date	Description
A	15/06/2020	Originated from V4/TRK/075/010 Draft B
B	03/07/2020	Added encoding, streaming, and recording blocks
C	13/07/2020	Added Configuration overview (section), Added to video output display description () and video interface block ()
D	03/08/2020	Added Platform protocol message id 0x07 to section 5.2.2.40 Added definition of platform protocol message formats 0x01, 0x02 and 0x03 to section 5.4.3
E	13/08/2020	Added reversionary track control items 5.2.1.46 and 5.2.1.47 Added track list output max tracks item 5.2.1.33 Corrected description of Closed Loop Control on First Tag, item 5.2.2.43 Moved line of sight compensation to section 4.2.6 Added to section 4.2.2.4 and 4.2.3.1 to better explain cue and tag numbering Added section 4.2.7.3 to explain platform control during concurrent cue and tag Added further explanation of the track list output messages in section 5.5
F	18/8/2020	Corrected tag numbering in section 5.5 Removed periodic message control items from sub-systems and included in section 5.1.5 instead Added sections 4.1.3 and 5.2.5 which describe the Synthetic test target functionality Added further detail to section 4.2.7.3 Added section 5.5.3 to explain track list output in concurrent Cue and Tag mode
G	29/09/2020	Updated section 5.1.1 to reflect multiple instances of the command and status protocol Updated section 5.4.1 and 5.5.1 to reflect the number of instances of each protocol that can be created Renamed section 4.1.1 and added sections 4.1.2 and 5.2.11 to document video AGC function Added description of additional camera status line display control in section 5.2.3.3 Added disk space item description in section 5.2.8.5 Corrected encoder codec enumerations in section 5.2.7.1 Added section 5.2.7.7 to report on encoder status Added section 3.2 to better explain configuration groups and command and status page allocation.
H	13/11/2020	Removed redundant Object Location Mode command from section 5.2.3 Added content to Image stabilisation section 4.3 Added addition configuration outputs from section 5.2.1.71 to 5.2.1.76 Added video input status items 5.2.4.12 – 5.2.4.14 Added extra symbology controls 5.2.3.23 – 5.2.3.27
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J	02/02/2021	Added 5.2.12 describing the Electronic Stabilisation sub-system of the CHARM protocol. Updated 4.3.5 to update defaults and add missing parameters

Revision	Date	Description
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1.0.5	11/10/2022	Added Class-Based Automatic Target Reacquisition description in section 4.2.3.4 Added Class-Based Automatic Target Reacquisition description in section 4.2.3.6 and control in sections 5.2.1.13 and 5.2.1.15 Section 4.5.2 * removed option for ‘nRateControl constant quality’ * removed 2nd ‘nRateControl’ in table * Added ‘H.264’ to add context to AVC. * max bit rate is 60000 kbit/s
1.0.6	01/11/2022	Update to the “Periodic Message Frequency” message section 5.1.5.1
1.0.7	19/12/2022	Added 5.2.1.34 Setting priority detection target from ID Added 5.2.1.66 Detected Object Minimum Age Corrected Identifier in section 5.2.1.70 Cue Obscura Scale Added Object Tracking Quality Threshold to Tracked Target Sub-System section 5.2.16
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Revision	Date	Description
1.0.9	22/02/2023	V2.3.11519 Added Encoder applicability into section 5.2.7 Added Fusion Source messages section 5.2.14.3 and 5.2.14.4 Added Fusion Bypass mode see section 5.2.14.1 Update to Fusion Warp input sections 5.2.14.5 to 5.2.14.13
1.0.10	06/04/2023	V2.3.11519 Added classifier to Object detection algorithm section 5.2.1.14
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1.0.12	19/06/2023	V2.3.12824 Added messages for Manual Track Window size changes Sections 4.2.8.1, 4.2.8.2 5.2.1.67,5.2.1.68, 5.2.1.69 and 5.2.3.13
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1.0.14	22/11/2023	V2.3.14149 Correction to the units in section 5.2.4.20 Added Detected Target List sub-system (0x1D) Section 5.2.13

Referenced Documents

Reference	Document
1	CHARM User Symbology Software Specification Vision4ce document V4/TRK/017/005 Revision 1.3

1. Scope

This document specifies the software functions and interfaces of the Vision4ce Video Processing Framework Software 'FrameWorkx'.

The document includes:

- Descriptions of the software functions available within FrameWorkx e.g. Video Tracking.
- A full definition of the command and status interface protocols supported by FrameWorkx.
- Explanation of the configuration file entries that are used to configure FrameWorkx at runtime.

2. Overview

The FrameWorkx software is often supplied as part of a Vision4ce image processing product. Not all Vision4ce products support all the FrameWorkx functions, it is important to read this document in conjunction with the relevant product specification which will list the FrameWorkx functions supported by the product.

FrameWorkx software can also be supplied as a standalone software application or dynamic link library. In this case the available functions will be limited by the license file supplied with the FrameWorkx software.

The FrameWorkx software includes a number of discrete functional process blocks.

1. Video input
2. Video tracking
3. Image enhancement
4. Image stabilisation
5. Video display
6. Video encoding
7. Video streaming
8. Object Detection and Classification
9. Test Target Generations (Optional)
10. Image Fusion
11. Image Warp

This document provides an overview of the operation of each of the process blocks and a link to their configuration, control, and status parameters.

3. Configuration and Processes

3.1. Overview

Configuration groups are key to the FrameWorkx architecture. Each configuration group includes configuration sets that describe the process blocks that form the framework and interface objects that provide control and status of the process blocks.

FrameWorkx can support one or more configuration group. Each configuration group can support one or more concurrent video input channels. However, each video input can only be used in one configuration group. At the moment each configuration group can only support one video tracker instance.

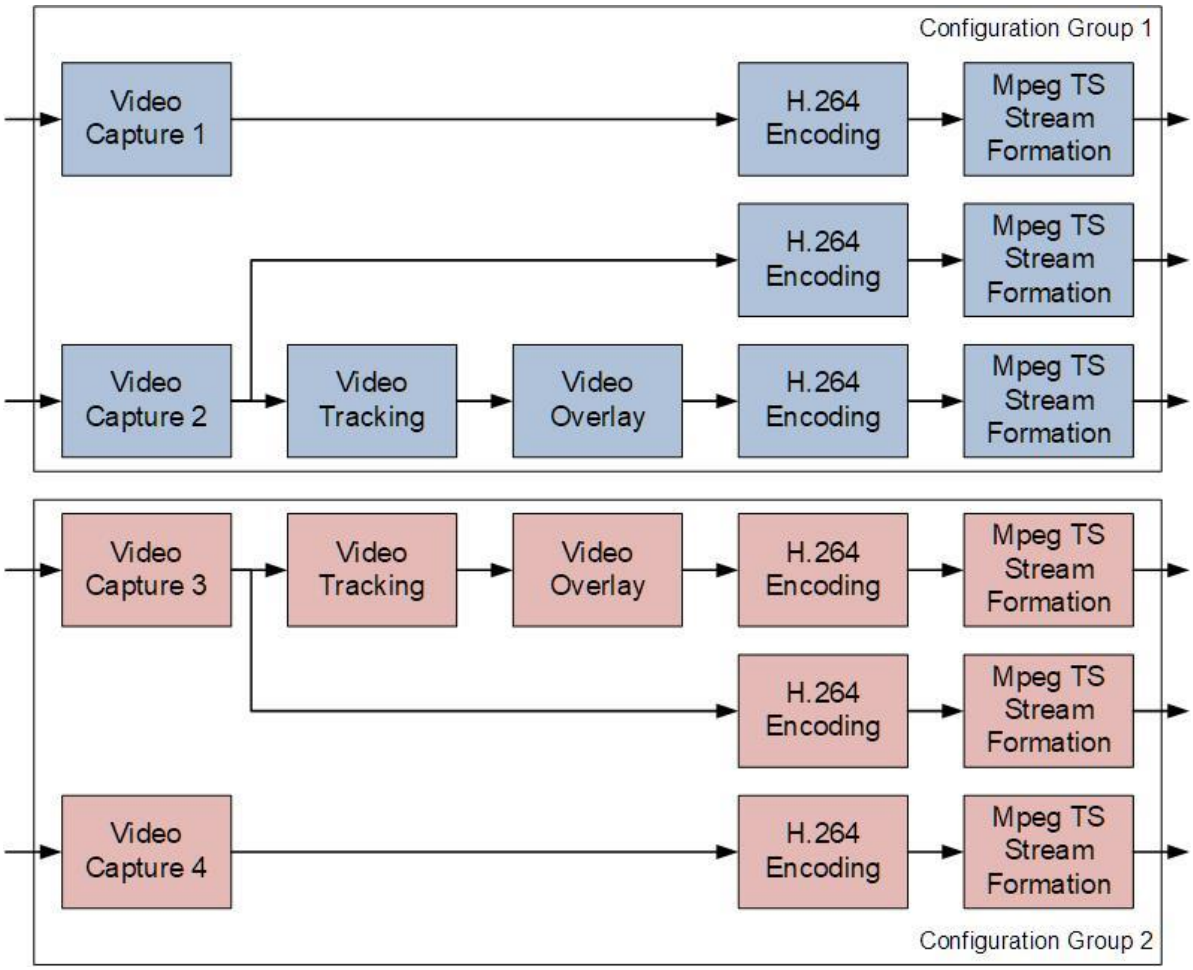


Figure 1 - Configuration Groups

3.2. Run Time Configuration

Most process blocks support run time configuration through the Command and Status protocol (see section 5.1 below). As the functionality within any given instance of FrameWorkx varies, the mapping of configuration pages within the Command and Status protocol also varies. However, the contents of each configuration page (e.g. the configuration page associated with the symbology overlay) will remain the same across all FrameWorkx instances.

The mapping of the configuration pages within the Command and Status protocol will be defined within the appropriate product specification.

4. Functional Descriptions

4.1. Video Input

4.1.1. Multiple Video Inputs

The FrameWorkx application software can be configured to receive and process multiple video inputs through any of the Video input sources available on the host hardware.

Where possible the FrameWorkx application software will automatically adapt to handle the input video standards, e.g. PAL / NTSC on composite video inputs, or 720p50 / 1080p30 on HD-SDI video inputs. The product specification for the host hardware shall detail the available video inputs.

The FrameWorkx application software can also be configured to receive video streams over Ethernet, both compressed, using MpegTs and RTSP containers, and uncompressed.

4.1.2. 16-bit Video Processing

FrameWorkx can receive pixel intensities with a dynamic range of up to 16 bits. The application uses an Automatic Gain Control (AGC) algorithm to convert the input pixel intensities to an 8bit dynamic range before they are processed. The AGC algorithm calculates new offset and gain values after receipt of each video frame. The calculated offset and gain are applied as follows.

$$IntensityProcessed = (IntensityReceived - OffsetAGC) * GainAGC$$

The AGC algorithm can be controlled through the Command and Status protocol, see section 5.2.11 below. The AGC algorithm is only present for specific video capture types, when configured for 16-bit video capture. The relevant product specification shall detail when the AGC algorithm is being used.

4.1.3. Synthetic Test Targets

Two Synthetic Test Targets are available, which may be overlaid on the incoming video prior to running the image processing functions to present user controllable targets in the video for training purposes. The tracker will process these targets without prior knowledge of their positions and sizes beyond what is derived by the image processing and the object tracking mode may be engaged on those targets to drive the platform system in the absence of any real targets within the image. The targets follow user defined trajectories with defined sizes and are independently controlled.

The commands to control the synthetic test targets are described in section 5.2.5 below. Note that all synthetic test target positions are defined in the same coordinate frame as the input platform line of sight (see section 4.2.6 and 5.4.4).

Three methods of definition of the synthetic target trajectory are supported.

4.1.3.1. Polar Position

The synthetic test target is placed at the user defined initial position.

4.1.3.2. Polar Speed

The synthetic test target starts at the user defined initial position; in subsequent video frames the target position is calculated using the user defined horizontal and vertical speeds. Position limits are defined to constrain the target motion.

4.1.3.3. Cartesian

The synthetic test target position is placed at the user controlled cartesian position. The user can update the Cartesian position once per video frame.

4.2. Video Tracking

Video tracking is implemented through the Vision4ce DART (Detection & Acquisition, with Robust Tracking) software library and is specifically configured to provide an embedded video tracking product.

A video tracker analyses video image sequences from a sensor system (camera), mounted on a servo controlled pedestal (platform) to keep the camera pointing at the nominated object.

In this context the Tracker has two primary processing functions

1. Detecting and locating objects of interest in the video image (object location)
2. Controlling the platform (Pan and Tilt) position and rate such that the camera follows the designated object (Pan and Tilt Control)

The typical integration of the Tracker with an electro optical sensor system is shown below:

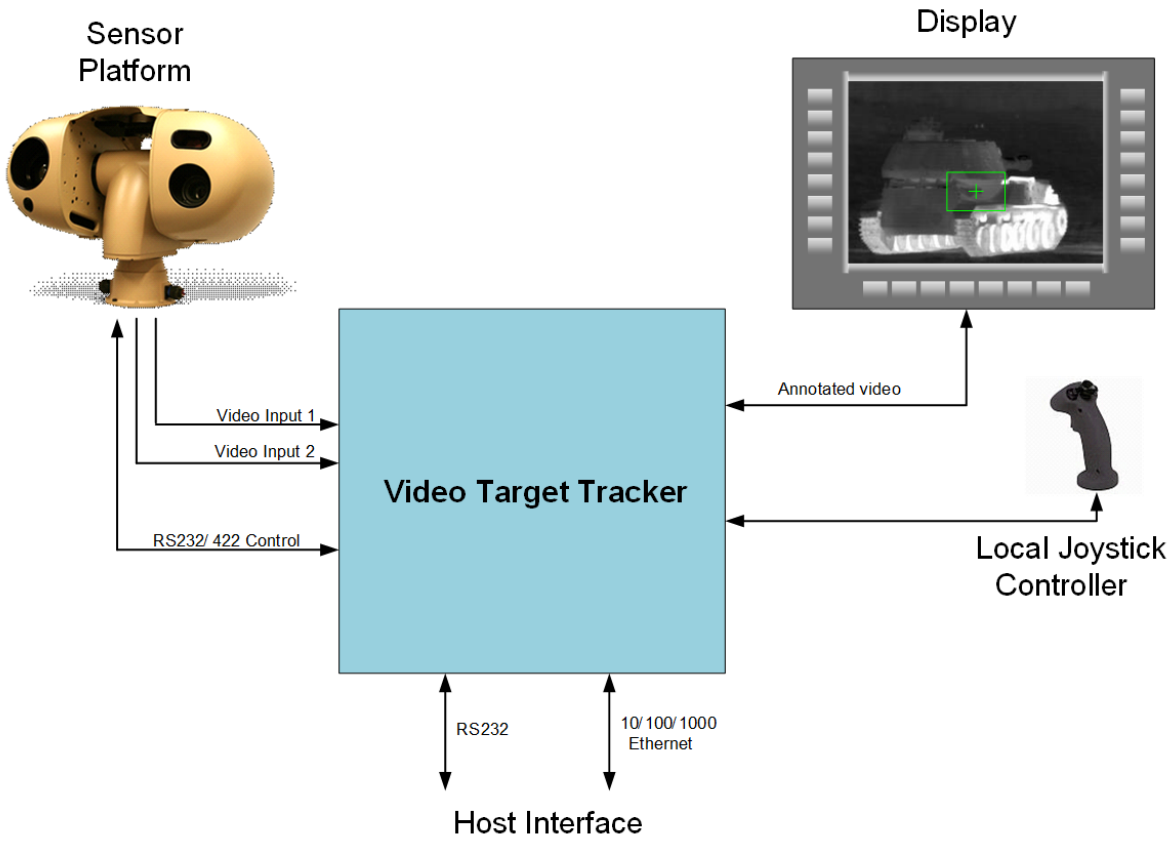


Figure 2 - Typical System Block Diagram

In the FrameWorkx configuration any one of the available video inputs can be selected to be processed for video tracking at any one time. This selection is made through the Video Input Channel command (see section 5.2.4.1 below). The mapping of the interface values to the video inputs supported by the hardware will be defined in the relevant product specification.

4.2.1. Object Location Overview

The Object Location function of the video tracker can itself be broken down into two processes, Cueing (Object Detection) and Tagging (Target Tracking). Concurrent Cue and Tag can be performed with up to five tagged targets.

To locate an object within the input video it is necessary to differentiate the object from the surrounding background. In order for the tracker to perform this task the image of the object must meet certain criteria (see section 4.2.9 below).

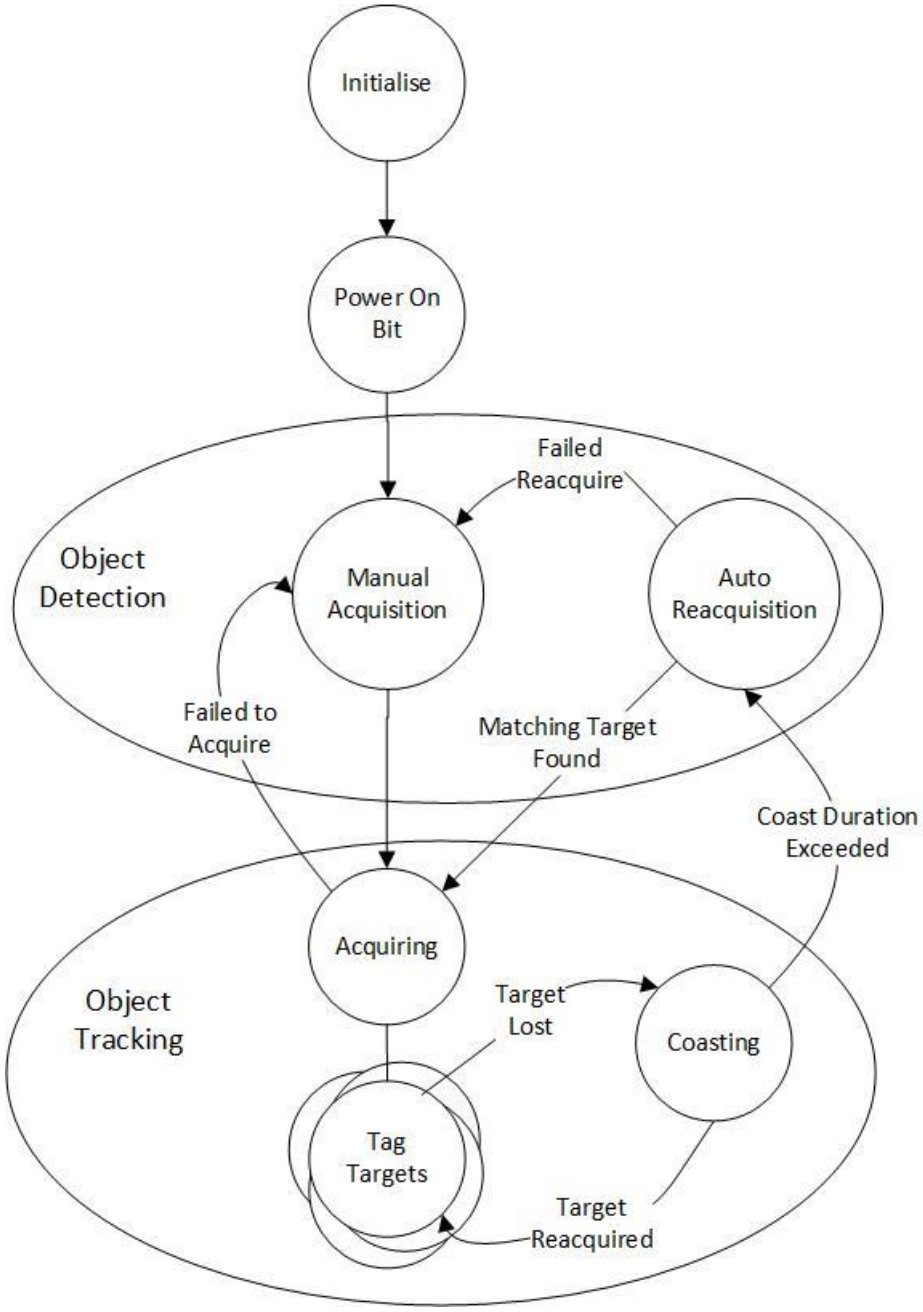


Figure 3 - Object Location Process Flow

4.2.2. Object Detection

4.2.2.1. Operation

The Object Detection process starts when the tracker has completed power-on initialisation and power-on BIT. Object Detection stops when:

- It is disabled by the operator.

4.2.2.2. Area of Interest

The Object Detection process operates over a user defined rectangular region of the input video, the 'area of interest'. The size and position of the area of interest is controlled through the tracker's control interfaces.

4.2.2.3. Object Criteria

The Object Detection process is designed to 'detect' objects that meet a defined set of object criteria (e.g. size).

4.2.2.4. Object Reporting

The position and size of the highest priority object is reported in on-screen symbology and through the tracker control interfaces. The object priority metric is selectable between largest and closest to the camera Boresight. The Hot Spot, Motion and Naval algorithms are able to detect and report multiple objects. The tracker can be configured to report these objects in on-screen symbology and through the tracker control interfaces.

When an object is detected, it will be assigned a track number. The track number will be unique at the time of assignment.

4.2.2.5. Detection Algorithm

The following detection algorithms are available:

Manual - allows the user to manually size an inner gate within the detection window.

This is a useful algorithm for targets which do not have a clearly defined bound or in a cluttered environment where the other modes do not correctly localise the target. It is very predictable and will always find something to track within the inner gate. It does, however, require that the target be centred in the field of view (FOV) and the inner gate must be suitably sized to contain the target and exclude background clutter.

Hot Spot - detects objects based on their contrast with respect to the background.

Reacts rapidly to targets entering the detection window and accurately determines target size. Works well for a wide range of target to detection window size ratios. The target must have contrast (negative or positive) with respect to any other objects or background present in the detection window. i.e., this algorithm needs bland backgrounds and little clutter. Overall, this algorithm offers very good performance for high contrast targets, e.g. air targets viewed by an IR camera.

Motion - detects objects based on their motion with respect to the background.

The algorithm detects objects that have either positive or negative contrast and are moving with respect to the background within the detection window. Works well in cluttered scenes, e.g. urban scenarios or those with a lot of trees etc., and with a wide range of target to detection size ratios. However, sometimes only the leading edge of a target will be detected and the requirement for movement means that it takes some time to detect targets. Good general purpose detection algorithm, especially in cluttered scenes.

Naval – contrast based detection optimised for naval targets.

This is similar to the hot spot detection algorithm and detects objects that have either positive or negative contrast with respect to the background. The algorithm is optimised for the detection of small and medium size targets in a naval environment and copes well with the horizontal background gradients of horizons. Reacts rapidly to targets entering the detection window and offers particularly good performance in naval scenes viewed with IR cameras.

Classifier – detects and classifies objects (not available on all platforms).

This algorithm leverages machine learning to learn the appearance of common objects and can be trained to learn unsupported objects as per customer request. The classifier is optimised for colour imagery and can cope with partial occlusions, contrast change, changes in size, and cluttered scenes. This algorithm is best used when there is a requirement to discriminate detections by object name. The classifier can reliably predict the class of medium sized objects and is less reliable on smaller objects. Pairing this algorithm with an additional sensor (such as radar) to assist with small object detection, provides a powerful solution.

4.2.3. Target Tracking (Tagging)

4.2.3.1. Operation

The Target Tracking process is started and stopped on command. The Target Tracking process uses object information from the Object Detection process to initiate the tag. The Tracked Object shall retain the track number that was assigned to the detected object (Cue). In addition each Tagged Target has a separate, unique, numeric ID.

It is possible to configure the tracker so that if no object has been detected when the Target Tracking process is commanded to start, the process is self-initialized based on the scene information around the centre of the Object Detection area of interest (see 5.2.1.47 below).

It is possible to configure the tracker so that the Target Tracking process is automatically started when the Object Detection process locates an object, see the state diagram above and 5.2.1.2 below.

4.2.3.2. Area of Interest

The Object Tracking process operates over an area of interest of the input video. The size and position of the area of interest is automatically controlled by the video tracker to exclude non-target pixels from the object position calculation.

4.2.3.3. Coast

If the tracker is unable to locate the object it was previously tracking (e.g. due to obscuration by the background), the Target Tracking process enters a search or ‘Coast’ mode. During Coast mode the tracker uses historic target position and size information to attempt to locate and re-acquire the target. If the target is located within the defined Coast mode duration, then normal Target Tracking is resumed. If the target has not been located by the end of the Coast mode duration, the Target Tracking process is then terminated. If the system is not in concurrent cue and tag mode the Object Detection process is re-started, see the state diagram above.

4.2.3.4. Class-Based Automatic Target Reacquisition

This automatically reacquires lost targets based on matching class and target properties. This algorithm automatically acquires targets that are determined to be a match to a recently lost target. Acquisition decisions are based on multiple properties of candidate targets and require that the class of the candidate target matches that of the lost target. Automatic target reacquisition removes requirement for manual reacquisition of the target following loss of a track in order to reduce burden on the operator. This algorithm is particularly effective in scenes with few targets, regardless of background. This feature is only available to systems that include classification.

4.2.3.5. Object Reporting

The position and size of the Tracked Object is reported in on-screen symbology and through the tracker control interfaces.

4.2.3.6. Track Algorithms

The following track algorithms are available:

Centroid – measures target positions by differentiating target pixels from background pixels based on their intensity or contrast and then calculating the centre of the target pixels.

The algorithm is designed to operate on bounded objects (blobs). It is able to estimate target size and adapt to changes in the target size. It copes well with target dynamics (acceleration etc.) and target contrast changes (e.g., due to background variations or changes in sensor gain and offset) but is susceptible to seduction by bright points in the background or target obscuration. The algorithm performs well with rapidly changing objects on bland backgrounds, e.g., aircraft with IR camera.

Correlation – measures target positions by finding the best match between a historical image of the target (pattern) and the incoming image.

The algorithm is designed to operate on objects within a complex scene or on a part of the target (such as the bridge of a large ship). It offers predictable performance and copes successfully with “coast” events caused by target obscuration. Works well on large and small targets but rapid target changes can cause the algorithm to lose track,

e.g. manoeuvring aircraft. Sensor automatic gain control (AGC) changes can cause the algorithm to enter coast mode when tracking small targets and the algorithm may not be able to follow rapid target motion, e.g. elevation nod in a very narrow FOV. The algorithm exhibits very good performance on slowly changing targets, particularly those at long range (i.e. where AGC changes are slow).

MTT – measures multiple target positions using the selected detection algorithm.

For situations where multiple target tracking is required the MTT algorithm should be selected. In this mode of operation target positions are determined using the selected detection algorithm (except manual). MTT is more suited to bounded objects and performs better than the centroid algorithm in clutter.

Combined – measures target positions using a combination of centroid and correlation algorithms.

The combined algorithm performs better than the correlation algorithm with rapidly changing targets and is better in clutter than the centroid algorithm. This algorithm is a good general purpose default selection especially where a variety of targets and backgrounds need to be accommodated.

Scenelock – measures motion of the whole scene using a modified large area correlation process.

The Scenelock algorithm is designed to estimate the motion of the whole scene and ignore the motion of the small targets. This algorithm is useful when trying to stabilise the motion of the electro optical system.

Neural Net Assisted Correlator – uses neural network based object detection and classification to refine the correlation tracker. (Only available on AI enabled systems)

This algorithm uses the Correlation tracker and updates the target based on object locations and classes from the Neural Network based detection and classification algorithms. It has similar predictability and high performance as the Correlation tracker but provides enhanced adaptability to rapid changes of the target, increased probability of reacquisition during coast events and reduced frequency of seduction by false targets due to improved bounding of the target. This feature is only available to systems that include classification and will perform best on target types that the classifier is optimised for.

4.2.4. Video coordinate system

The size of the video input depends on the particular piece of hardware being used and its video interfaces. The tracker coordinate system uses the captured video frame as the basis of its coordinate system.

4.2.4.1. Camera Boresight

The position of the camera Boresight is defined relative to the top left of the processed video frame, using a positive right and down coordinate set. The camera processing limits are defined in the same coordinate set.

4.2.4.2. Object Position

The tracker measures object positions by calculating the location of the object Aimpoint with respect to the Boresight position within the video frame, using a positive right and up coordinate set. The position of the tracker area of interest is defined in the same coordinate set.

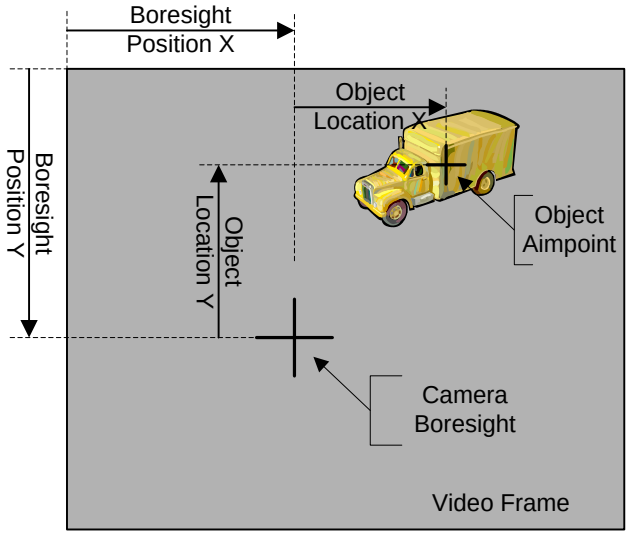


Figure 4 - Object Location calculation

The exact definition of the object Aimpoint is dependent on the Object Track algorithm selected:

TRACK ALGORITHM	AIMPOINT
Centroid	Target centre
MTT	Target centre
Correlation	Match position
Combined	Target centre or match position
Scenelock	Scene centre

4.2.5. Camera Compensation

The following camera parameters can be compensated by the tracker software:

4.2.5.1. Camera Field of View

The Camera field of view can be input from the host interface. Normally this would be updated at the video frame rate providing a field of view value corresponding to each frame of video. The tracking filters operate in and angular frame of reference. Therefore, if camera field of view feedback is provided then the tracking will be un-affected by a change in the field of view and the platform control will also be compensated for changes in the sensor field of view.

4.2.5.2. Camera Boresight

The Camera Boresight can be set and modified from the host interface.

4.2.5.3. Camera Active Video

The active video region within the video image can be set and modified from the host interface.

4.2.5.4. Camera Latency

The latency of the camera video can be set and modified from the host interface. This is necessary when performing target position reconstruction, i.e. combining the results of the video processing with the platform line of sight feedback to calculate the target position with respect to the platform.

The commands used to configure the camera compensation are listed in sections 5.2.4.

4.2.6. Line of Sight Compensation

The tracking filters operate in an angular frame of reference. This can be corrected for line of sight (platform) motion using angular rate or position feedback. The feedback data is provided though the host interface along with the associated data latency. When line of sight feedback is provided, the tracking will be un-affected by angular motion.

Where the line of sight data is provided by an inertial sensor, the line of sight compensation will correct for angular movement of the pan and tilt and also angular motion of the platform on which the pan and tilt is mounted (Ship, vehicle or airframe).

4.2.7. Platform Control

4.2.7.1. Manual Mode Control

A manual mode rate demand can be set and modified from the host interface.

4.2.7.2. Track Mode Control

In target track mode, the video tracker can calculate a rate demand which can be used by the host system to control a pan and tilt platform. In order to generate these rate demands, the target to boresight errors in azimuth and elevation are passed through simple digital filters with the following format:

$$Rate_t = Gain * (P_0 * Error_t + P_1 * Error_{t-1}) + I_1 * Rate_{t-1}$$

Where:

$Rate_t$	Rate demand (filter output) for this cycle
$Rate_{t-1}$	Rate demand (filter output) for the previous cycle
$Error_t$	Target to boresight error for this cycle
$Error_{t-1}$	Target to boresight error for the previous cycle
$Gain$	Filter gain
P_0	Filter parameter
P_1	Filter parameter
I_1	Filter parameter

The simplest form of the filter implements a proportional filter:

$$Rate_t = Gain * Error_t$$

$Gain$	Variable Gain
P_0	1.0
P_1	0.0
I_1	0.0

The gain can be varied to get the desired platform response. Higher gain will give a faster response, but with risk of overshoot or instability whereas lower will be more sluggish. This filter will give a zero steady state error and a fixed error for targets moving at a fixed (non-zero) velocity.

The full form of the filter implements a proportional / integral filter:

$$Rate_t = Gain * (P_0 * Error_t + P_1 * Error_{t-1}) + I_1 * Rate_{t-1}$$

$Gain$	Variable Gain
P_0	1.0 + w/100 (e.g. 1.02)
P_1	-1.0 + w/100 (e.g. -0.98)
I_1	1.0

The gain and breakpoint frequency (represented by w) can be varied to get the desired platform response. Once settled, this filter will give a zero error for a target moving at a fixed velocity and a fixed error for a fixed (non-zero) acceleration.

The output of the platform filters is coasted at a constant rate when the tracked target enters Coast mode.

The commands used to configure the operation of the platform control functions are listed in section 5.2.2 below.

4.2.7.3. 'Closed Loop' Tag

In concurrent cue and tag mode, one of the tagged targets may be selected as the closed loop tag. It is the measured target to Boresight error of this tag that is used to calculate the platform rate demand.

Closed Loop control output is not automatically switched to a newly Tagged Target unless requested by the user. Closed Loop Control output may be switched between multiple Tag targets upon user request. If the closed loop tag selection is changed, a controlled switch to closed loop control using the new tag target to Boresight error will be performed.

The commands used to select the closed loop tag are listed in sections 5.2.2.42 and 5.2.2.43

4.2.8. Video Tracking Symbology

4.2.8.1. Object Detection

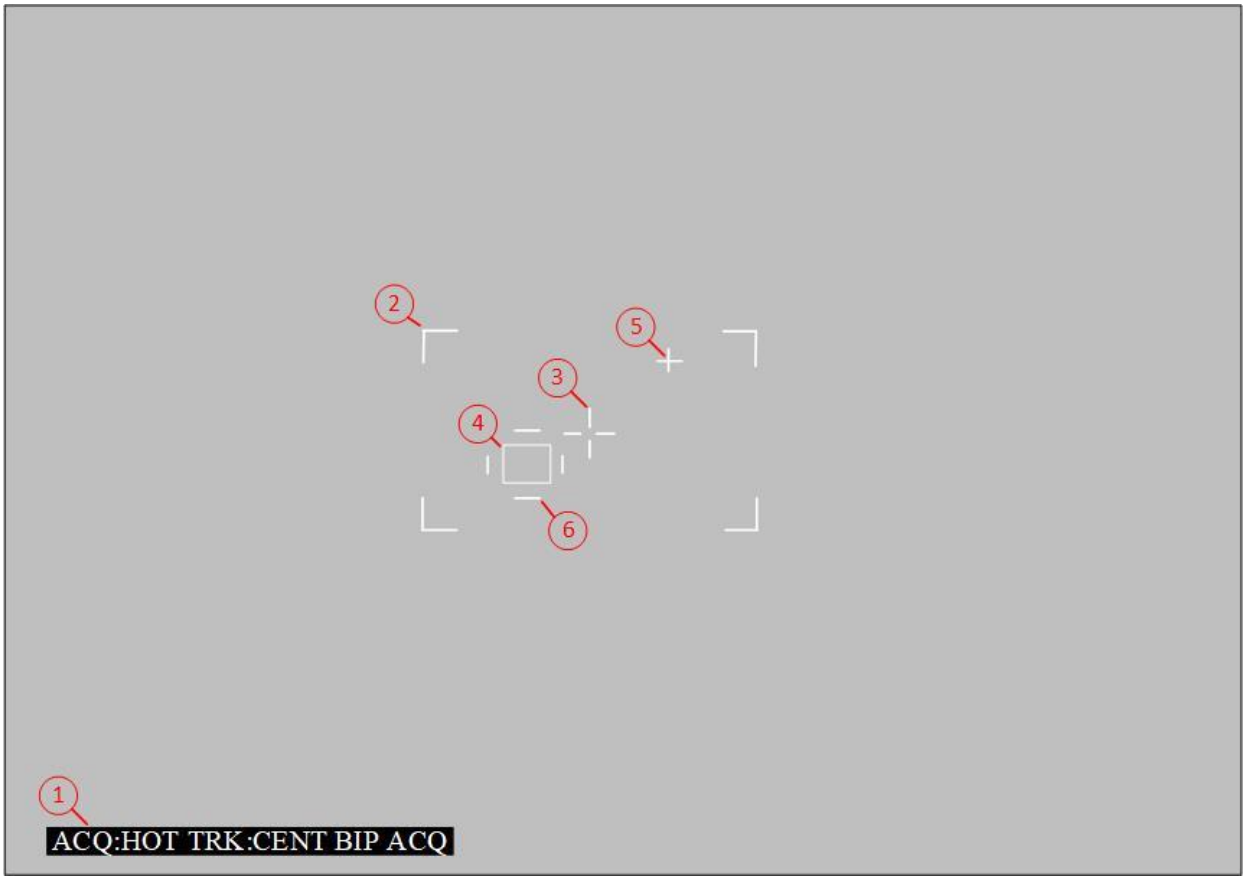


Figure 5 - Object Detection Symbology

1. Status Line
   ACQ:111 TRK:222 333 444
   Where:
   111 – Acquisition Algorithm
   222 – Track Algorithm
   333 – Polarity
   444 – Tracker Mode (Acquisition)
2. Detection Area of interest (Open Box)
3. Camera Boresight (Open Cross)
4. Primary detection target (Closed Box)
5. Secondary detection targets (Closed crosses)
6. Manual Track Window Size

4.2.8.2. Object Tracking

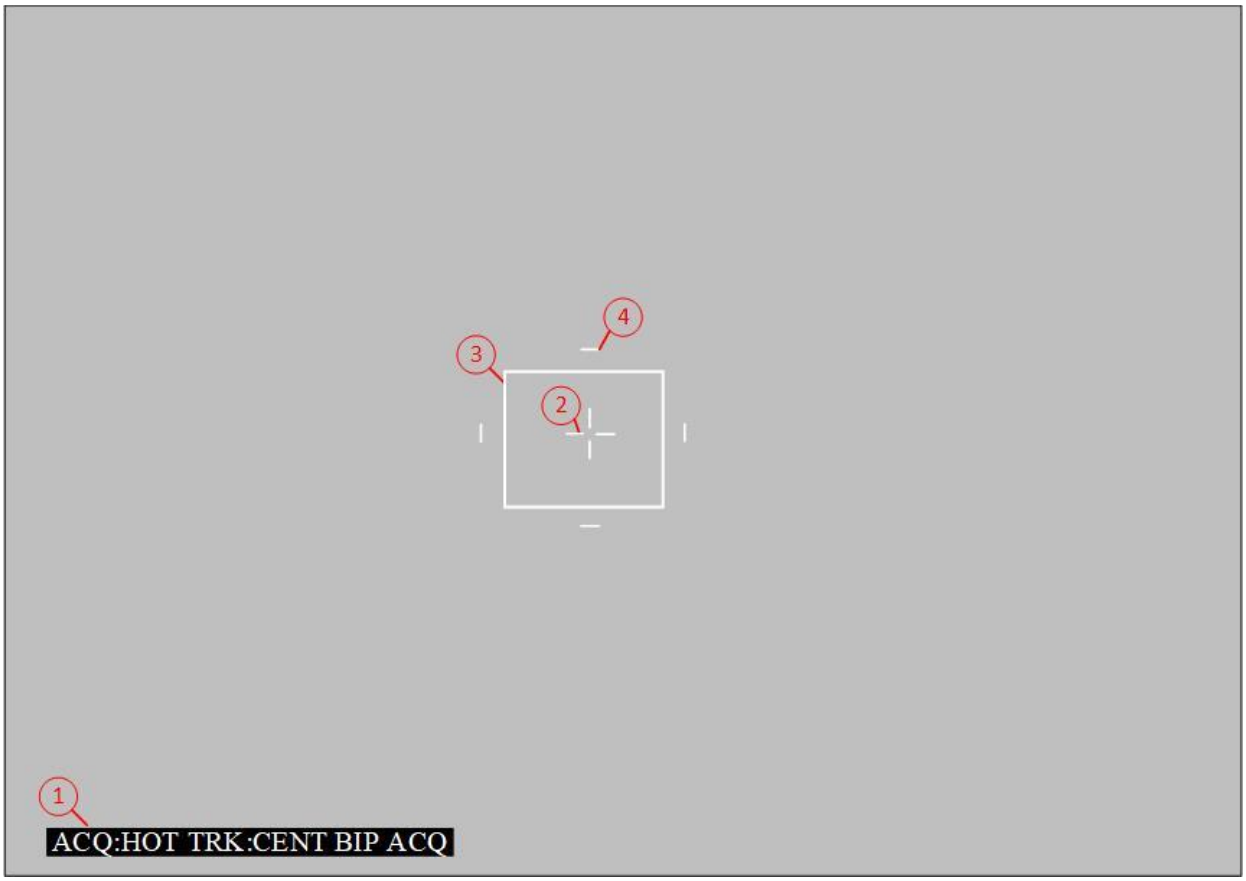


Figure 6 - Object Tracking Symbology

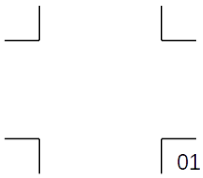
1. Status Line
   ACQ:111 TRK:222 333 444
   Where:
   111 – Acquisition Algorithm
   222 – Track Algorithm
   333 – Polarity (Auto during track)
   444 – Tracker Mode (TRK for tracking or CST for coasting)
2. Camera Boresight (Open Cross)
3. Tracked target (Closed Box) or Coasting target (Horizontal Bars)
4. Manual Track Window Size

4.2.8.3. Concurrent Cue and Tag

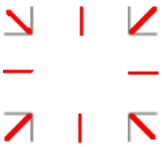
Concurrent cue and tag requires a change in symbology in order for the operator to be able to easily distinguish between target types. There are various target types:

- Cues
  - Primary Cue
  - Secondary Cues
- Tags
  - Closed loop tag
  - Secondary tags

The primary cue symbology is a closed box, and secondary cue symbology are small crosses. Tag symbology uses an inverted corner with an optional tagged target ID label. An inverted corner box allows an operator to distinguish tags from cues, whilst minimising the impact of the symbology on the target image.



In addition to the corner boxes an indication of the Tracking Aimpoint Bias (Centroid) can be seen in one of the 8 locations shown below in red (this is only supported in Cue and Tag mode).



The status line information shows the current cue configuration and the algorithm selection for the next tag.

4.2.8.4. Hot Spot Acquisition Threshold Gauge

When Hot Spot Acquisition is being used, a threshold gauge can optionally be displayed on the video output:

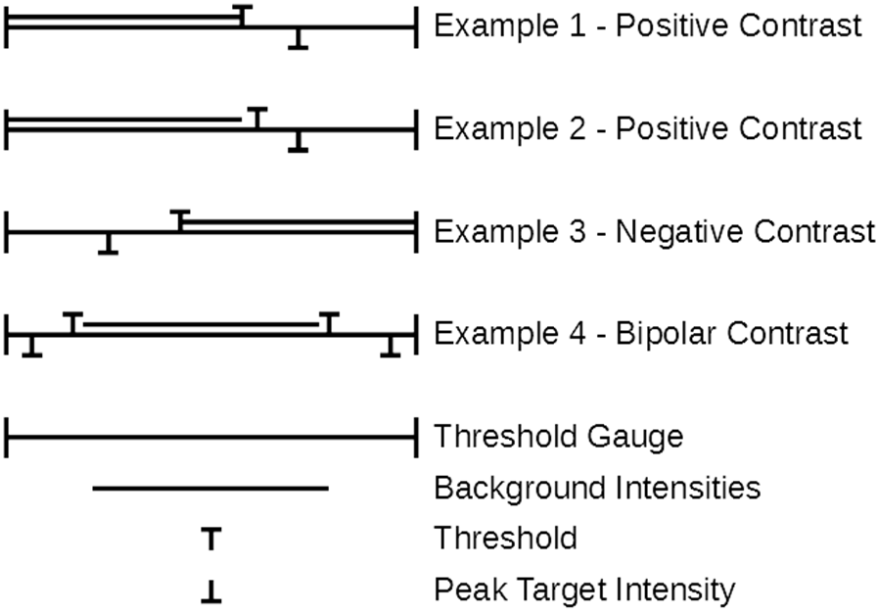


Figure 7 - Threshold Gauge Symbology

4.2.9. Performance Specification

4.2.9.1. Specification

The following parameters constitute a composite performance statement, i.e. if all the object's parameters are met the tracker detects and tracks the object with the specified accuracy. Conversely it is possible (for example) for the tracker to detect and track objects with a contrast lower than that specified if the signal to noise ratio is sufficiently high.

Accuracy of Position Output	<0.25 pixels
RMS noise on Position Output	<0.5 pixels
Minimum object contrast	5%
Minimum object Signal to Noise Ratio	4.0
Minimum Target Size	6 x 4 frame pixels
Maximum Target Size	220 x 160 pixels
Maximum Target Speed	Greater of 25% of target size, or 8 pixels per field

4.2.9.2. Definitions

The contrast of an object is defined as follows:

$$\frac{100\ x\ (AverageTargetIntensity - AverageBackgroundIntensity)}{Peak\ White\ Intensity}$$

The signal to noise ratio of an object is defined as follows:

$$\frac{AverageTargetIntensity - AverageBackgroundIntensity}{RMS\ Noise}$$

4.3. Image Stabilisation

4.3.1. Overview

Image stabilisation is designed to enhance the quality of the video by removing undesired camera motion. It is possible to remove jitter produced by the camera motions in both x and y directions which essentially locks the scene into steady motion in the output.

4.3.2. Area of Interest

An Area of Interest (AOI) can be applied to the input image to prevent image artefacts, such as black borders, causing the stabilisation algorithm to underperform. As the frame arrives in the image stabilisation process block, the AOI is calculated based on the configured border parameter and the width and the height of the image. The AOI is then passed to the registration function of the image stabilisation.

Calculation of AOI using Border parameter is defined as follows:

- Top Left X=Image Width x Border(x)
- Top Left Y=Image Height x Border(y)
- Bottom Right X=Image Width- TL(x)
- Bottom Right Y=Image Height- TL(y)

4.3.3. Registration

There are two properties used during the image registration function that determine the output stabilisation warp: slew and fixate.

These properties are used during the process of adaptive relaxation. The aim of the adaptive relaxation is to handle both the situation where a camera is rapidly moving to look at a new location (slew), and the situation where a camera is observing a single location (fixate). The magnitude of the slew warp determines whether the slew alpha or the stabilisation alpha is applied to calculate the value of the relaxation factor. If the slew magnitude is low, then an assumption can be made that the camera is looking at a fixed point(fixate). If the magnitude is high, then the assumption is that the scene is moving (slew).

Different filter coefficients are used in the slew and fixate situations in order to let through more of the real camera motion in slew and try to stabilise well in fixate.

4.3.4. Image Transformation

Once the stabilisation warp has been calculation, the stabilisation data is then passed to process image transformation. There are two options available for image transformation in the stabilisation process which are Translation and Affine transformation.

4.3.5. Configuration File Parameters

Parameter	Description	Default value
`fSlewAlpha`	Used as a multiplier to calculate the magnitude of stabilisation relaxation factor during the slew state. The relaxation factor controls the rate at which the stabilised image returns to the current image.	0.6
`fRelaxAlpha`	Controls the rate at which the relaxation factor changes from the slew to stabilise state and vice versa	0.995
`fSlewMag`	Magnitude of the warp matrix transitioning from stabilise to slew.	400.0
`fStabAlpha`	Used as a multiplier to calculate the magnitude of stabilisation relaxation factor during the stabilise state. The relaxation factor controls the rate at which the stabilised image returns to the current image.	0.95
`fBorderX`	Rate used as a multiplier to calculate the x position of top left and bottom right of AOI (Area of interest) in the input image.	0.1 (10% of image width)
`fBorderY`	Rate used as a multiplier to calculate the y position of top left and bottom right of AOI (Area of interest) in the input image.	0.1 (10% of image width)
`bFilterWarp`	Enabled filtering of the output warp, which enables the adaptive relaxation process	1
`bResetWarp`	Reset the stabilisation warp (when E-stab is first initialized for example)	0
`nParams`	Number of parameters to use in registration.	2
`fEstabZoom`	The zoom factor applied the stabilised image, which is used to prevent black borders appearing in the output image	1.1

4.4. Video Display

4.4.1. Overview

The video display will be composed from the currently active video inputs. Each display may be comprised of several video windows, each showing the video captured from a single input.

The video display also includes a symbology overlay capability. The symbology overlay can be formed from several sources.

- The overlay generated by the video tracking instance (see section 4.2 above). The symbology is described in section 4.2.8 above, and the commands to control the symbology overlay are listed in section 5.2.3 below.
- Video timestamp, as described in section 4.4.4 below
- User symbology overlay, as described in section 4.4.5 below

4.4.2. Video Output Formation

In the case of Vision4ce hardware platforms the video output will typically be formed directly from the input video in the video processing FPGA. This will result in a very low latency video output; the timing and resolution of the output video will exactly match that of the input video signal.

In most other hardware platforms, the video output will be provided through the platform operating system display manager.

4.4.3. Video Window Control
By default, the size and position of each video window is set to match that of the video display that it is part of. The size of position of the video window can also be set through the configuration file and also the remote-control protocol (see section 5.2.10 below).

4.4.4. Video Timestamp Display
A frame timestamp can be displayed on the video overlay and recorded video. This is enabled via the Timestamp Enable, Timestamp Position X and Timestamp Position Y messages.

4.4.5. User Symbology
User defined text can be displayed at user specified positions on the overlaid video output and the streamed video output. The protocol for user symbology is defined in Reference 1 (CHARM User Symbology Software Specification) and will be operated through a different UDP port to the existing control and output protocols.

4.4.6. Synthetic Test Targets
4.4.6.1. Overview.
Two Synthetic Test Targets are available, which may be overlaid on the incoming video prior to running the image processing functions to present user controllable targets in the video for training purposes. The tracker will process these targets without prior knowledge of their positions and sizes beyond what is derived by the image processing and the object tracking mode may be engaged on those targets to drive the platform system in the absence of any real targets within the image. The targets follow user defined trajectories with defined sizes and are independently controlled.

4.5. Video Encoding and Streaming
Each Video Encoder instance can be connected to one or more Streamer or Recorder instances. A number of different Streamer and Recorder types are supported, not all Streamer and Recorder types are compatible with all Video Encoder types.

Separate remote control protocol block instances are provided for each encoder, streamer and recorder instances, see section 5.2.7, 5.2.8 and 5.2.9.

4.5.1. Encoder Configuration
Encoder configuration is held within the `Encoder` xml tag, and also within a configuration tag that is specific to the encoder that is in use. The following `Encoder` configuration elements are read at application start.

Parameter	Description	Default value
`nMsgHandlerId`	Sets the id of the remote control message handler block associated with the encoder	N/A
`nSkippedFrames`	Set the number of input frames that are skipped before the next frame is encoded	0

4.5.2. `V4_EncMSDK` Configuration
Configuration for the MSDK H.264 encoder is held under the `EncMSDK` xml tag.

Parameter	Description	Default value
`id`	Sets the id of the encoder that will read this configuration block	N/A
`nBitRate`	Set the target bit-rate for the H.264 encoding in kbit/s, maximum 60000 kbits/s	2000

Parameter	Description	Default value
nRateControl	Sets the H.264 bit-rate function 1 – constant bit rate (CBR) 2 – variable bit rate (VBR)	2
nProfile	Selects the H.264 encoding profile 0 – Baseline 1 – Main 2 – Extended 3 – High	0
nLevel	Sets the H.264 encoding rate 09 – 1b, 10 – 1, 11 – 1.1, 12 – 1.2, 13 – 1.3 20 – 2, 21 – 2.1, 22 – 2.2 30 – 3, 31 – 3.1, 32 – 3.2 40 – 4, 41 – 4.1, 42 – 4.2 50 – 5, 51 – 5.1	30
fFrameRate	Sets the framerate reported in the encoded video stream	30.0
nGOP	Sets the number of frames included in each group of pictures	5
nCodecId	Sets the codec that is used 0 – AVC (H.264) 3 - JPEG	0
nQuality	Selects the JPEG quality 1 .. 100	80

4.5.3. V4_EncNvMMapiMPEG Configuration

Configuration for the MPEG encoder is held under the EncNvMMapiMPEGCfg xml tag.

Parameter	Description	Default value
id	Sets the id of the encoder that will read this configuration block	N/A
eEncoderFmt	Sets the encoder format H264, H265	H264
eProfile	Selects the H.264 encoding profile 0 – Baseline 1 – Main 2 – Extended 3 – High	1
eLevel	Sets the Mpeg encoding rate _1_0, _1B, _1_1, _1_2, _1_3, _2_0, _2_1, _2_2, _3_0, _3_1, _3_2, _4_0, _4_1, _4_2, _5_0, _5_1	5.1
nBitRate	Set the target bit-rate for the H.264 encoding (kbit/s)	2048
nPeakBitRate	Set the peak bit-rate for the H.264 encoding (kbit/s)	4096
nFrameRate	Sets the framerate reported in the encoded video stream	100
eRateControlMode	Sets the rate control method 1 – CBR 2 – VBR	1
nWidth	Sets the width on the input image	1280
nHeight	Sets the height on the input image	720

4.5.4. V4_EncGst Configuration

Configuration for the GStreamer encoder is held under the EncGst xml tag.

Parameter	Description	Default value
id	Sets the id of the encoder that will read this configuration block	N/A
sPipeline	Sets the input pipeline name	

4.6. Object Detection and Classification

4.6.1. Operation

Classification is performed by a Convolution Neural Network (CNN) which is configured with network weights derived from a customer specific training process. The weights are used to generate an inferencing engine, which is an optimised implementation of the neural network. The engine is optimised specifically for the GPU that it will be executed on and is loaded at application runtime. The engine can be changed via configuration file, as well as other configuration parameters detailed below. As mentioned earlier in this document, the algorithm is a selectable detection algorithm. Please note that the classifier can only run on CHARM or GRIP computers that contain an NVIDIA GPU.

4.6.2. Region of Interest

The processing region is determined by the input resolution of the neural network, typically this is 416x416. The position of the processing region can be adjusted on the fly however the size is restricted to the neural net input resolution.

To increase the size of the ROI, the inferencing engine should be rebuilt with an increased batch size. This is an offline process that will allow multiple images to be processed together. Depending on the type of GPU, this operation will be performed in parallel or sequentially. Sequential processing will incur an increased processing latency per additional image in the batch.

4.6.3. Outputs

The output from the Classification process is a list of 0 or more regions, all of which have been predicted as having a probability of belonging to one of the configured classes.

The output can be filtered to only include classes of interest. To do so, enable the ‘bFilterClasses’ flag, and specify the path to a file that contains the class IDs, one per line.

Class ID are available upon request.

4.6.4. Augmented Target List

As described in section 5.5.6.4, the Classifier Augmented Target List is an additional Target Data Format and is available for output for both Detected Targets (Cues), message ID 0x07, and Tracker Targets (Tags), message ID 0x08.

4.6.5. Classifier Configuration

Configuration for the classifier can be found under the `ClassifierCfg` xml element.

Parameter	Description	Default value
id	Sets the id of the classifier that will read this configuration block	N/A
bEnabled	If enabled the inferencing engine will be loaded at app runtime	0
fMinConfidenceFilter	The minimum confidence score of reported detections	0.25
fNMSThreshold	Non-max suppression threshold for bounding box prior selection	0.25
bScaleImage	Increase the AOI to maximum square (height x height scaled down to classifier input size)	false

Parameter	Description	Default value
m_bDebug	Show classifier prediction output via SSH console	false
m_bTimeInference	Time how long it takes to process an image	false
bFilterClasses	Restrict the output predictions to only include specified class IDs	False
classFilterFile	Path to a file containing class IDs of interest	“”

Configuration for the inferencing engine can be found under the trtEngineCfg xml element.

Parameter	Description	Default value
enginePath	The file path to the inferencing engine	N/A
nBatchSize	Number of images per batch	1
tileInput	Divide the image into tiles for batch processing	false
inputHeight	Neural Network input height in pixels	416
inputWidth	Neural Network input width in pixels	416
m_inputChannels	Neural Network input channels	3
m_classListFile	Path to a file containing a list of class names in order	coco.names
outputFormat	The type of detection head	yolov3

Configuration of each image within a batch can be found under the tile’s xml element. Each <tile> should have a unique ID. A tile represents an image within the batch.

Parameter	Description	Default value
topLeftX	The offset in pixels of the top left of the tile	N/A
topLeftY	The offset in pixels of the top left of the tile	N/A

4.7. Image Warping

The Image Warping process can be used to apply a warp to the input video which is composed of roll, scale and translation. This can be used to apply a digital zoom or sensor roll compensation for example. The warp function uses bilinear interpolation.

4.8. Image Fusion

The Image Fusion process can be used to blend two images together to present the operator with a single image that contains data from more than one sensor (for example TV and IR). Two fusion techniques are available – a simple additive fusion which shows for example a 50:50 or 80:20 blend of the two inputs and multi-resolution fusion which aims to keep high contrast data (edges) from both inputs. The fusion process includes independent warping of the two images to allow the scene from the two cameras to be aligned.

5. Interface Protocols

The default IP address, unless specified differently by a project is 10.0.0.2

5.1. Command and Status Protocol

5.1.1. Protocol Overview

Command and Status messages can be communicated through the Ethernet or serial ports on the hardware hosting FrameWorkx (FrameWorkx device). One or more instances of the command and status protocol can be created for each defined Configuration group.

Ethernet Transport Protocol:	UDP
Ethernet Port Number:	9876 (Receive data)

The FrameWorkx device starts transmitting output messages following receipt of an input message. The UDP output messages are sent to the IP address of the received message.

The host device sends ‘Command’ messages to the FrameWorkx device and in response receives ‘Status’ messages. The format of the data within the messages is binary. The communication protocol provides half duplex communication; the host device should not transmit another command message until it has received a response to the previous command message.

Command messages may write data items to the FrameWorkx device, or request a read of data items, which will be returned in a Status message. The command data may, for example, select the operating mode of the video tracker function within FrameWorkx.

Each Command message may consist of one or more data write or read commands, each of these is referred to as a ‘data item’. Similarly, each Status message may contain 1 or more data item.

Section 5.3 below of this document contains some sample messages with an explanation of how they were created.

5.1.2. Data Items

Data items consist of an identification byte followed by one or more optional data bytes. Setting the most significant bit of the identification byte indicates a request to read the specified data item. Similarly clearing the most significant bit of the identification byte indicates a request to write to the data item.

Not all data items support both read and write access, this is specified in the description of the data item.

Responses from the protocol to data item reads, always have the most significant bit of the identification byte cleared.

The optional data bytes of the data item are in one of the following formats:

- Byte (1 byte)
- Signed word (2 bytes)
- Unsigned word (2 bytes)
- Signed integer (4 bytes)
- Fixed point (4 bytes with 12 fractional bits)[1]
- IEEE Floating point (4 bytes)
- Signed long integer (S64) (8 bytes)
- Bit field (1 or more bytes, least significant byte first)
- String (1 byte for length followed by n (<255) bytes (n+1 bytes))

[1] See section 5.3.2 for an example in the response message.

Multiple byte data items to be sent in the order of most significant byte to least significant byte, unless otherwise stated.

The data format is specified in the description of each data item which can be found in section 5.2 below.

5.1.2.1. Read Request

Setting the most significant bit of the identifier byte indicates a request to read the specified data item.

And example of this can be found in section 5.3.2

5.1.2.2. Write Request

Clearing the most significant bit of the identifier byte indicates a request to write the specified data item.

And example of this can be found in section 5.3.1

5.1.3. Command Message

Every Command message issued to the protocol has the following structure.

Offset	Length (Bytes)	Value	Name	Description
0	1	0x10	Header	
1	1		Sub-system ID	(Object Location / Symbology / Platform etc.)
2	1		Reserved	
3	1	N	Data length	The maximum data length is 255 bytes
4	N		Data	Multiple data items
N+4	1		Checksum	Modulo 256 sum of bytes 0 to N + 3

5.1.3.1. Sub-system ID

Each command message is addressed to a particular sub-system of the FrameWorkx application. The sub-systems allow for logical grouping of data items.

5.1.3.2. Data Item Processing

The protocol processes the bytes within a command message sequentially from byte 0. Hence a message containing a read data item after a write to the same data item reads back the data that has just been written.

5.1.4. Status Message

The FrameWorkx device issues response, periodic and warning status messages.

- Response messages are issued in response to a command message.
- Periodic messages are issued at the rate specified by the periodic message rate data item (see section 5.1.5.1 below) and contain the data specified by the periodic message contents data item (see section 5.1.5.2 below).
- Warning messages are issued upon the FrameWorkx device encountering a BIT warning or BIT error.
- The sub-systems that support periodic and warning status messages will be identified in another section of this document.

Every Status message issued by the protocol has the following structure.

Offset	Length (Bytes)	Value	Name	Description
0	1	0x10	Header	
1	1		Sub-system ID	Sub-system ID
2	1		Status	Message origin and BIT state
3	1	N	Data length	The maximum data length is 255 bytes
4	N		Data	Multiple data items
N+4	1		Checksum	Modulo 256 sum of bytes 0 to N + 3

5.1.4.1. Status Byte Overview

The Status Byte provides three separate pieces of information.

Bit	7 (MSb)	6	5	4	3	2	1	0 (LSb)
Function	Transmission Trigger		Command Message Status				Warnings	Errors

5.1.4.2. Transmission Trigger

The two most significant bits of the Status byte constitute a 2-bit unsigned integer that indicates the cause of transmission of the Status Message as follows:

0 – Status message issued in response to receipt of a Command message
1 – Periodic status message
2 – Warning status message

5.1.4.3. Command Message Status

The middle four bits of the Status byte constitute a 4-bit unsigned integer that indicates whether the receipt of the last Command message was successful, as follows:

0 – Message received successfully
1 – Checksum failure
2 – Unknown data item received

5.1.4.4. Warnings

The second least significant bit (bit 1) of the ‘Status’ byte is a logical ‘OR’ of all the BIT warning bits, if this bit is not set there are no warnings in force.

5.1.4.5. Errors

The least significant bit is a logical ‘OR’ of all the BIT error bits, if this bit is not set, no error conditions have been detected.

5.1.5. Periodic Messages

All sub-systems support periodic status message outputs. This function is controlled by 2 data items in each subsystem. As data items that are common across all sub-systems, these are not explicitly listed in the data items for each sub-system but listed here instead.

5.1.5.1. Periodic Message Frequency

Identifier	0x70
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0 (Disabled)
Description	Set the rate at which the periodic status message is output

- 0x00 – Disabled — No periodic output.
- 0x01 – Cycle Rate — The periodic message is output upon completion of each cycle. For blocks 0x00, 0x01, 0x02, 0x03 and 0x04 the cycle is the frame rate, for the other blocks the cycle it 100ms.
- 0x0n – Other — Values greater than 0x01 will cause (n-1) processing cycles to be skipped between the output of each periodic message.
- 0xFF – On Change — Periodic message output when there is a change in value of any of the content in the periodic message.

5.1.5.2. Periodic Message Contents Definition

Identifier	0x71
Access	Read and write
Data bytes	16
Data format	Bit field
Data default	0 (No data items output)
Description	These bit fields specify the data items to be included in the Periodic status message. For example, to include data item 0x40, set bit 64 of this bit field. Note that subject to the maximum data length of the status message up to 64 data items may be selected for output at the same time.

5.2. Command and Status Protocol Data Items

The following identifiers will be unavailable if the system is not configured for Cue and Tag mode of Video tracking operation.

- Object Location Sub-System (ID 0x00): Identifiers 0x75 to 0x7D
- Pan and Tilt Control Sub-System (ID 0x01): Identifiers 0x52 and 0x53
- Tracked Target Sub-System (ID 0x8X): All Identifiers

5.2.1. Object Location Sub-System (ID 0x00)

When concurrent cue and tag is enabled, items representing the track configuration shall be used to initialise the equivalent parameters in the tag configuration subsystems (0x8X). Changes to these values will not affect existing tags. Once established, tags can individually have their configuration altered.

5.2.1.1. Object Tracking Mode

Identifier 0x00
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command is used to control the Object Tracking process; the following data values are valid

- 0x00 – Disable This will enable the Object detection process.
- 0x01 – Enable
- 0x02 – Coast This command may be used to ‘force’ the Tracking process into coast mode.

5.2.1.2. Automatic Tracking Mode Selection

Identifier 0x01
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command causes the Object Tracking process to automatically start when an object is detected

- 0x00 – Disable.
- 0x01 – Enable.

5.2.1.3. Automatic Tracking Arm Delay (Cue and Tag only)

Identifier 0x02
Access Read and write
Data bytes 4
Data format Fixed Point
Data default 0.0
Description Arm delay time in seconds, behaviour specified by the selected Arm Mode (0x0B).

5.2.1.4. Tracking Coast Duration

Identifier 0x03
Access Read and write
Data bytes 4
Data format Fixed Point
Data units Seconds
Data default 2.0
Description This command sets the maximum duration of the Tracking Coast Mode

5.2.1.5. Detection Priority Metric

Identifier 0x04
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Largest)
Description This command sets the object detection priority metric

- 0x00 – None The first detected object will be the highest priority..
- 0x01 – Size The largest object will be the highest priority.
- 0x02 – Position The object closest to the camera Boresight will be the highest priority.
- 0x03 – Combined Priority is calculated based on size and distance from the Boresight, larger objects that are closer to the Boresight have higher priority.
- 0x05 – AOI Position The object closest to the detection area of interest will be the highest priority.
- 0x06 – AOI Combined Priority is calculated based on size and distance from the centre of the area of interest, larger objects that are closer to the centre of the AOI have higher priority.

5.2.1.6. Detection Target Polarity

Identifier 0x05
Access Read and write
Data bytes 1
Data format Byte
Data default 2 (Bipolar)
Description This command sets the polarity of the Object Detection Algorithm

- 0x00 – Positive (White or bright targets)
- 0x01 – Negative (Black or dark targets)
- 0x02 – Bipolar
- 0x03 – Automatic

5.2.1.7. Tracking Aimpoint Bias

Identifier 0x06
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Centre)
Description This command sets the Aimpoint Bias (selected edge) of the Object Tracking Algorithm. Note that this is currently only supported by the Centroid Algorithm.

- 0x00 – Centre
- 0x01 – Top Right
- 0x02 – Right
- 0x03 – Bottom Right
- 0x04 – Bottom
- 0x05 – Bottom Left
- 0x06 – Left
- 0x07 – Top Left
- 0x08 – Top
- 0x09 – Automatic

5.2.1.8. Track Target to Gate Scaling X

Identifier	0x07
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	2.0
Description	Defines the size of the track gate relative to target size. Note that this is currently only supported by the Centroid Algorithm.

5.2.1.9. Track Target to Gate Scaling Y

Identifier	0x08
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	2.0
Description	Defines the size of the track gate relative to target size. Note that this is currently only supported by the Centroid Algorithm.

5.2.1.10. Track Target to Gate Scaling Min Border X

Identifier	0x09
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	24.0
Description	When the above Target to Gate Scaling is applied, this value is used to set a minimum border for the gate size compared to the target as shown below. i.e. by default the minimum gate size will be Target Size + 24 pixels. Note that this is currently only supported by the Centroid Algorithm. Gate size = MAX (Target Size * Target to Gate Scaling, Target Size + Target to Gate Scaling Min Border)

5.2.1.11. Track Target to Gate Scaling Min Border Y

Identifier	0x0A
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	18.0
Description	When the above Target to Gate Scaling is applied, this value is used to set a minimum border for the gate size compared to the target as shown below. i.e. by default the minimum gate size will be Target Size + 18 pixels. Note that this is currently only supported by the Centroid Algorithm. Gate size = MAX (Target Size * Target to Gate Scaling, Target Size + Target to Gate Scaling Min Border)

5.2.1.12. Auto Tracking Arm Mode (Cue and Tag only)

Identifier 0x0B
Access Read and write
Data bytes 1
Data format Byte
Data default 0
Description This command determines the behaviour of the Auto Tracking Arm Mode

- 0x00 = Default — Arm activates only once. The Arm Delay (0x02) is not applicable.
- 0x01 – Reserved — Reserved.
- 0x02 – Timed re-arm — Timed re-arm. If a Track that has been activated by the Arm command fails within the period defined by the Arm Delay time (0x02) then Arm will be reactivated. To de-activate this mode the Arm Delay time should also be set to 0.0.

5.2.1.13. Enable Class Based Reacquisition

Identifier 0x0C
Access Read and write
Data bytes 1
Data format Byte
Data default 0
Description This enables and disables the class based reacquisition

- 0 (Disabled)
- 1 (Enabled) — AI Enabled systems only

5.2.1.14. Object Detection Algorithm

Identifier 0x0E
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Manual)
Description This command sets the algorithm used within the Object Location process

- 0x00 – Manual — The AOI position and size is used as information to initiate the Tracking process.
- 0x01 – Hot Spot — Objects are detected based on their intensity in relation to the background.
- 0x02 – Motion — Objects are detected based on their motion in relation to the background.
- 0x03 – Naval — Optimised for the Naval environment
- 0x04 – NOT USED
- 0x05 – Classifier — Objects are detected using the classifier — AI Enabled systems only
- 0x06 – NOT USED
- 0x07 – NOT USED

5.2.1.15. Object Track Algorithm

Identifier 0x0F
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Combined)
Description This command sets the algorithm used within the Object Tracking process

- 0x00 – Combined
- 0x01 – Correlation
- 0x02 – MTT
- 0x03 – Centroid
- 0x04 – Scenelock

- 0x05 – Neural Net Assisted Correlator AI Enabled systems only

5.2.1.16. Detection Area of Interest Position X

Identifier	0x10
Access	Read and write
Data bytes	2
Data format	Signed Word
Data units	Pixels, origin is the Camera Boresight, positive is right
Data default	0
Description	This command is used to position the area processed for Object Detection

5.2.1.17. Detection Area of Interest Position Y

Identifier	0x11
Access	Read and write
Data bytes	2
Data format	Signed Word
Data units	Pixels, origin is the Camera Boresight, positive is up
Data default	0
Description	This command is used to position the area processed for Object Detection

5.2.1.18. Detection Area of Interest Size X

Identifier	0x12
Access	Read and write
Data bytes	2
Data format	Signed Word
Data units	Pixels
Data default	320
Description	This command is used to size the area processed for Object Detection

5.2.1.19. Detection Area of Interest Size Y

Identifier	0x13
Access	Read and write
Data bytes	2
Data format	Signed Word
Data units	Pixels
Data default	240
Description	This command is used to size the area processed for Object Detection

5.2.1.20. Track Area of Interest Size Adjustment X

Identifier	0x15
Access	Write
Data bytes	1
Data format	Signed Byte
Data range	-128 to 127
Data default	0
Description	This command is used to modify the X size of the Track mode Correlation AOI. Positive values increase the AOI size. Any value written to this parameter will be consumed and added to the current track AOI size prior to the next image process cycle. The input is automatically cleared when consumed so there is no need write a zero value to stop subsequent size changes.

5.2.1.21. Track Area of Interest Size Adjustment Y

Identifier	0x16
Access	Write
Data bytes	1
Data format	Signed Byte
Data range	-128 to 127
Data default	0
Description	This command is used to modify the Y size of the Track mode Correlation AOI. Positive values increase the AOI size. Any value written to this parameter will be consumed and added to the current track AOI size prior to the next image process cycle. The input is automatically cleared when consumed so there is no need write a zero value to stop subsequent size changes.

5.2.1.22. Track Area of Interest Position Adjustment X

Identifier	0x17
Access	Write
Data bytes	1
Data format	Signed Byte
Data range	-128 to 127
Data default	0
Description	This command is used to modify the X position of the Track mode Correlation AOI with relation to the tracked target. Positive values move the AOI position to the right. Any value written to this parameter will be consumed and added to the current track AOI position after to the next image process cycle and will force a new reference image to be prepared at the new target position. The input is automatically cleared when consumed so there is no need write a zero value to stop subsequent position changes.

5.2.1.23. Track Area of Interest Position Adjustment Y

Identifier	0x18
Access	Write
Data bytes	1
Data format	Signed Byte
Data range	-128 to 127
Data default	0
Description	This command is used to modify the Y position of the Track mode Correlation AOI with relation to the tracked target. Positive values move the AOI position upwards. Any value written to this parameter will be consumed and added to the current track AOI position after to the next image process cycle and will force a new reference image to be prepared at the new target position. The input is automatically cleared when consumed so there is no need write a zero value to stop subsequent position changes.

5.2.1.24. Object Tracking Uses Platform LOS

Identifier	0x19
Access	Read and write
Data bytes	1
Data format	Byte
Data range	0 (Disabled) or 1 (Enabled)
Data default	0 (Disabled)
Description	This command is used to indicate if the tracker should take Platform Interface Line of Sight data into account when calculating target positions. This feature uses a filter for time interpolation between platform updates and does not operate unless the filter is also enabled. See 5.2.2.28 Line of Sight Calculation Mode and related settings.

5.2.1.25. Object Tracking Quality Threshold

Identifier	0x20
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data range	0.0 to 1.0
Data default	0.125
Description	This command is used to set the quality threshold. When the evaluated track quality is less than this value the Object Tracking process will enter coast mode. A value of 0.0 will mean that coast mode will not be used. A value of 1.0 will mean that coast mode will be frequently entered.

5.2.1.26. Object Tracking Model Update Alpha

Identifier	0x25
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data range	0.0 to 1.0
Data default	0.04
Description	This command is used to set the coefficient used in the update of the Object Tracking target model. A value of 0.0 will mean that the target model will not be updated, a value of 1.0 will mean that the target model is initialised on every tracking cycle

5.2.1.27. Object Tracking Prediction

Identifier	0x26
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0 (Disabled)
Description	Enables or disables the prediction of target position during tracking and coasting. Generally, this function should be enabled, but if the tracker has video from a moving platform with no line of sight feedback, it should be disabled.

- 0x00 – Disable
- 0x01 – Enable

5.2.1.28. Object Tracking Prediction Alpha

Identifier	0x27
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data range	0.0 to 1.0
Data default	0.04
Description	This command is used to set the coefficient used in the update of the target position model. A value of 0.0 will mean that the target position will not be updated, a value of 1.0 will mean that the target position is initialised on every tracking cycle. This should be used in conjunction with Object Tracking Prediction.

5.2.1.29. Track List Output Enable

Identifier 0x28
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (disabled)
Description Enables or Disables the Track List Output (see section 5.5)

- 0x00 – Disable
- 0x01 – Enable UDP
- 0x02 – Enable Serial

5.2.1.30. Track List Output Format

Identifier 0x29
Access Read and write
Data bytes 1
Data format Byte
Data default 0x1E (Image Coordinates)
Description Defines the contents of the Track List Output data (see section 5.5 below)

- 0x1E – Image relative coordinates
- 0x1F – Boresight relative coordinates

5.2.1.31. Track List Output Hysteresis

Identifier 0x2A
Access Read and write
Data bytes 4
Data format Fixed Point (seconds)
Data default 0.0 (Disabled)
Description This command defines the minimum time a track will be reported in a ranked position before swapping rank for a higher priority track.

5.2.1.32. Object Tracking Mode by Detect Track Id

Identifier 0x2B
Access Write only
Data bytes 1
Data format Byte
Data default 0 (no effect)
Description This command is used to request entry to track on a detected target (Cue) with a specified Track identification number as reported in the Track List (see section 5.5). If the track id is valid, object tracking process will be enabled at the position and size of the reported track. If the track id is not valid when the command is issued, no mode change will take place.

When concurrent cue and track is enabled (subsystem 0x00, ID 0x75, §5.2.1.87) then next available tag shall be used.

5.2.1.33. Track List Output Max Tracks

Identifier	0x2C
Access	Read and write
Data bytes	1
Data format	Byte
Data default	5
Description	Sets the maximum number of tracks that can be output in a single Track List Output message (see section 5.5 below)

5.2.1.34. Set Priority Target ID

Identifier	0x2D
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0
Description	Sets the ID of the designation target which will be deemed to be highest priority (The one which will be selected on the next track command). This can only be set when the detection priority (0x04) is set to None (0x00)

5.2.1.35. Detected Object Minimum Size X

Identifier	0x30
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	3
Description	This command defines the minimum size in the X axis for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.36. Detected Object Minimum Size Y

Identifier	0x31
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	2
Description	This command defines the minimum size in the Y axis for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.37. Detected Object Minimum Area

Identifier	0x32
Access	Read and write
Data bytes	4
Data format	Signed integer
Data units	Pixels
Data default	6
Description	This command defines the minimum object area for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.38. Detected Object Maximum Size X

Identifier	0x33
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	250
Description	This command defines the maximum size in the X axis for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.39. Detected Object Maximum Size Y

Identifier	0x34
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	250
Description	This command defines the maximum size in the Y axis for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.40. Detected Object Maximum Area

Identifier	0x35
Access	Read and write
Data bytes	4
Data format	Signed integer
Data units	Pixels
Data default	100000
Description	This command defines the maximum object area for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.41. Manual Detection uses Track Algorithm

Identifier	0x36
Access	Read and write
Data bytes	1
Data format	Byte
Data default	1 (Enabled)
Description	This command is an enable for the Manual Detection mode whereby, in the case of Centroid and Correlation track algorithm selection, an appropriate image process function will be performed during detection in an attempt to establish a suitable track AOI size to use on entry into object track mode rather than starting track with a Track AOI size half that of the Detect AOI with this disabled.

- 0x00 – Disable
- 0x01 – Enable

5.2.1.42. Use Clipped Objects

Identifier	0x3A
Access	Read and write
Data bytes	1
Data format	Byte
Data default	1 (Enabled)
Description	This command determines whether the tracker uses objects which touch the edge of the cueing window.

- 0x00 – Do not use clipped objects.

- 0x01 – Use clipped objects.

5.2.1.43. Hot Spot Acquire Threshold Mode

Identifier 0x3B
Access Read and write
Data bytes 1
Data format Byte
Data default 2 (Automatic)
Description This command determines the behaviour of the hot spot acquire threshold.

- 0x00 – Manual Threshold The threshold is set using the data supplied in identifier 0x3C below
- 0x01 – Manual Offset The threshold is set to be offset from the automatically calculated background intensity by the data supplied in identifier 0x3C below
- 0x02 – Automatic The threshold is calculated automatically

5.2.1.44. Hot Spot Acquire Threshold / Offset

Identifier 0x3C
Access Read and write
Data bytes 1
Data format Byte
Data default 16
Description Set the manual pre-processor threshold or offset as determined by the mode set in ID 0x3B

5.2.1.45. Hot Spot Acquire Threshold / Offset (16 bit)

Identifier 0x3D
Access Read and write
Data bytes 2
Data format Unsigned word
Data default 16
Description For 16-bit video processing only, set the manual pre-processor threshold or offset as determined by the mode set in ID 0x3B.

5.2.1.46. Enable Reversionary mode on Track Fail

Identifier 0x3E
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to enable the reversionary track function if an attempt to enter track fails. When enabled and an attempt to enter track fails, a Correlation track is initiated at the target location and size

- 0x00 – Disabled
- 0x01 – Enabled

5.2.1.47. Enable Reversionary mode on No Acquisition Target

Identifier 0x3F
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to enable the reversionary track function if an attempt to enter track is made when there is no Acquisition target. When enabled and an attempt to enter track is commanded when there is no Acquisition target, a Correlation track is initiated at the image Boresight

- 0x00 – Disabled
- 0x01 – Enabled

5.2.1.48. Primary Object Status

Identifier 0x40
Access Read only
Data bytes 1
Data format Byte
Description This value reports the status of the primary object detected or being tracked by the Tracker

- 0x00 – Invalid Object data is invalid (i.e. no object has been detected or is being tracked)
- 0x01 – Valid Object data is valid
- 0x02 – Coasting Object data is ageing (i.e. it has not been updated this cycle)

5.2.1.49. Primary Object Position X

Identifier 0x42
Access Read only
Data bytes 4
Data format Fixed Point
Data units Pixels, origin is the Camera Boresight, positive is right
Description This value reports the X axis location of the object Aimpoint

5.2.1.50. Primary Object Position Y

Identifier 0x43
Access Read only
Data bytes 4
Data format Fixed Point
Data units Pixels, origin is the Camera Boresight, positive is up
Description This value reports the Y axis location of the object Aimpoint

5.2.1.51. Primary Object Size X

Identifier 0x44
Access Read only
Data bytes 4
Data format Fixed Point
Data units Pixels
Description This value reports the X axis size of the object

5.2.1.52. Primary Object Size Y

Identifier	0x45
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Pixels
Description	This value reports the Y axis size of the object

5.2.1.53. Primary Object Rate X

Identifier	0x46
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Pixels per second Positive values only
Description	This value reports the X axis rate of the object with respect to the supplied line of sight data (see 5.2.2.28 below).

5.2.1.54. Primary Object Rate Y

Identifier	0x47
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Pixels per second Positive values only
Description	This value reports the Y axis rate of the object with respect to the supplied line of sight data (see 5.2.2.28 below).

5.2.1.55. Primary Object Quality

Identifier	0x48
Access	Read only
Data bytes	4
Data format	Fixed Point
Range	0.0 (low quality) to 1.0 (high quality)
Description	This value reports the quality calculated for the prime object. The quality is calculated based on the variance of a number of target parameters, size, contrast etc. In track mode the quality is compared to the Object Tracking Quality Threshold (see section 5.2.1.25 above), when the quality drop below the Threshold the system enters Coast mode (see4.2.3.3 above).

5.2.1.56. Primary Object Tracking in Reversion Mode

Identifier	0x49
Access	Read only
Data bytes	1
Data format	Byte
Description	

- 0x00 –False
- 0x01 – True

5.2.1.57. Detected Object Minimum Aspect

Identifier	0x4A
Access	Read and write
Data bytes	4
Data format	Fixed Point Positive values only
Data default	0.125
Description	This command defines the minimum aspect for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.58. Detected Object Maximum Aspect

Identifier	0x4B
Access	Read and write
Data bytes	4
Data format	Fixed Point Positive values only
Data default	2.5
Description	This command defines the maximum aspect for a detected object to be indicated on-screen and reported on the interface. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.59. Detected Object Minimum Intensity

Identifier	0x4C
Access	Read and write
Data bytes	2
Data format	Signed Word
Data default	0
Description	This command defines the minimum intensity for a detected object to be indicated on-screen and reported on the interface. The Intensity discriminant is only applicable when Object Detection Algorithm is Hot Spot Acquire and the Detection Target Polarity is either Positive or Negative. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.60. Detected Object Maximum Intensity

Identifier	0x4D
Access	Read and write
Data bytes	2
Data format	Signed Word
Data default	255
Description	This command defines the maximum intensity for a detected object to be indicated on-screen and reported on the interface. The Intensity discriminant is only applicable when Object Detection Algorithm is Hot Spot Acquire and the Detection Target Polarity is either Positive or Negative. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.61. Detected Object Minimum Speed

Identifier	0x4E
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0
Description	This command defines the minimum speed for a detected object to be indicated on-screen and reported on the interface. Disabled if set equal to the Maximum Speed. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.62. Detected Object Maximum Speed

Identifier	0x4F
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0
Description	This command defines the maximum speed for a detected object to be indicated on-screen and reported on the interface. Disabled if set equal to the Minimum Speed. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.63. Detected Object Minimum Direction

Identifier	0x50
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliradians
Data range	0 to 6283.18
Data default	0.0
Description	This command defines the minimum direction for a detected object to be indicated on-screen and reported on the interface. Defined as a clockwise direction relative to the 12 o'clock position on-screen where the valid arc represents the clockwise angle from the Minimum to Maximum Direction. Disabled if set equal to the Maximum Direction. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.64. Detected Object Maximum Direction

Identifier	0x51
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliradians
Data range	0 to 6283.18
Data default	0.0
Description	This command defines the maximum direction for a detected object to be indicated on-screen and reported on the interface. Defined as a clockwise direction relative to the 12 o'clock position on-screen where the valid arc represents the clockwise angle from the Minimum to Maximum Direction. Disabled if set equal to the Minimum Direction. Shall be disabled if both the Minimum and Maximum items are set to 0.

5.2.1.65. Detected Object Direction Minimum Speed

Identifier	0x52
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0
Description	This command defines the minimum speed of a detected object that is required in either axis for the direction discriminate to apply.

5.2.1.66. Detected Object Minimum Age

Identifier	0x53
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data default	6
Description	This command defines the minimum number of frames that an object should be detected for before it is reported on the interface.

5.2.1.67. Automatic Track Window Size

Identifier	0x54
Access	Read and write
Data bytes	1
Data format	Byte
Data default	1 (Enabled)
Description	This command is used to control automatic sizing of the Track Window. Manual Window sizing is not supported by Cue and Tag. ● 0x00 – Disable. ● 0x01 – Enable.

5.2.1.68. Manual Track Window Size X

Identifier	0x55
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	64
Description	This command defines the Manual Track Window Size in the X axis.

5.2.1.69. Manual Track Window Size Y

Identifier	0x56
Access	Read and write
Data bytes	2
Data format	Unsigned word
Data units	Pixels
Data default	32
Description	This command defines the Manual Track Window Size in the Y axis.

5.2.1.70. Cue Obscura Scale

Identifier	0x5F
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0
Description	This command defines the cue obscuration scaling factor. This scaling is applied to a tag area when determining whether it coincides with and should therefore suppress an underlying cue.

5.2.1.71. Application S/W Part Number

Identifier	0x62
Access	Read only
Data bytes	Variable
Data format	String
Description	Returns the application software part number, for example “V4-TRK-075-202”

5.2.1.72. Application S/W System Ident

Identifier	0x63
Access	Read only
Data bytes	4
Data format	Integer
Description	Returns the application software system ident, for example 75 from “V4-TRK-075-202”

5.2.1.73. Application S/W Sub-System Ident

Identifier	0x64
Access	Read only
Data bytes	4
Data format	Integer
Description	Returns the application software sub-system ident, for example 202 from “V4-TRK-075-202”

5.2.1.74. Application S/W Version

Identifier	0x65
Access	Read only
Data bytes	Variable
Data format	String
Description	Returns the application software version, for example “V2.1.5678”

5.2.1.75. Application Configuration Identifier

Identifier	0x66
Access	Read only
Data bytes	Variable
Data format	String
Description	Returns the application configuration file identification string

5.2.1.76. Module Configuration Identifier

Identifier	0x67
Access	Read only
Data bytes	Variable
Data format	String
Description	Returns the module configuration file identification string

5.2.1.77. BIT Warnings

Identifier	0x68
Access	Read only
Data bytes	4
Data format	Bit Field
Description	Outputs the currently active built-in test warnings

- Bit 0 – Video input warning
- Bit 1 – Video output warning
- Bit31 – BIT warning test

5.2.1.78. BIT Errors

Identifier 0x69
Access Read only
Data bytes 4
Data format Bit Field
Description Outputs the currently active built-in test errors

- Bit 0 – Video input error
- Bit 1 – Video output error
- Bit31 – BIT error test

5.2.1.79. BIT Warning Test

Identifier 0x6A
Access Read and write
Data bytes 1
Data format Byte
Description Controls the test bit of the BIT warning field (0x68) and can be used to test the BIT warning function

- 0 – BIT warning test bit cleared
- 1 – BIT warning test bit set

5.2.1.80. BIT Error Test

Identifier 0x6B
Access Read and write
Data bytes 1
Data format Byte
Description Controls the test bit of the BIT error field (0x69) and can be used to test the BIT error function

- 0 – BIT error test bit cleared
- 1 – BIT error test bit set

5.2.1.81. Restart Application Lock

Identifier 0x6C
Access Read and write
Data bytes 1
Data format Byte
Description Control whether or not to allow the application to be reset (via ID 0x6D)

- 0 – Restart application not allowed
- 1 – Restart application allowed

5.2.1.82. Restart Application

Identifier 0x6D
Access Write only
Data bytes 1
Data format Byte
Description Write non-zero value to restart application.(hardware dependent)

5.2.1.83. System Time

Identifier 0x6E
Access Read only
Data bytes 8
Data format U64
Units UTC microseconds since Jan 01 1970
Description Read the current system time on the FrameWorkx device – can be used to achieve an approximate alignment of time between systems.

5.2.1.84. S/W Major Version Number

Identifier 0x72
Access Read only
Data bytes 4
Data format Integer
Description Returns the S/W major version number

5.2.1.85. S/W Minor Version Number

Identifier 0x73
Access Read only
Data bytes 4
Data format Integer
Description Returns the S/W minor version number

5.2.1.86. S/W Major Revision Number

Identifier 0x74
Access Read only
Data bytes 4
Data format Integer
Description Returns the S/W revision number

5.2.1.87. Enable Concurrent Cue and Track

Identifier 0x75
Access Read and write
Data bytes 1
Data format Byte
Description

- 0x00 – Concurrent cue and track disabled
- 0x01 – Concurrent cue and track enabled

5.2.1.88. Force Track

Identifier 0x76
Access Read and write
Data bytes 1
Data format Byte
Description

- 0x00 – No action
- 0x01 – Attempt to force track at the location and size specified by items 0x77 to 0x7A
  Will be cleared to 0x00 when attempted.

5.2.1.89. Force Track Position X

Identifier 0x77
Access Read and write
Data bytes 2
Data format Signed Word
Data units Pixels, origin is the Camera Boresight, positive is up
Data Default 0
Description Set the X position for forced track attempt

5.2.1.90. Force Track Position Y

Identifier	0x78
Access	Read and write
Data bytes	2
Data format	Signed Word
Data units	Pixels, origin is the Camera Boresight, positive is up
Data Default	0
Description	Set the Y position for forced track attempt

5.2.1.91. Force Track Size X

Identifier	0x79
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels
Data Default	0
Description	Set the X position for forced track attempt

5.2.1.92. Force Track Size Y

Identifier	0x7A
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels
Data Default	0
Description	Set the Y position for forced track attempt

5.2.1.93. Clear all Tags

Identifier	0x7B
Access	Read and write
Data bytes	1
Data format	Byte
Description	Set to Immediately stop tracking on all tags

- 0x00 – No action
- 0x01 – Immediately stop tracking on all tags
  Will be cleared to 0x00 when attempted

5.2.1.94. Max Cues

Identifier	0x7C
Access	Read and write
Data bytes	1
Data format	Byte
Data default	5
Description	Set the maximum number of cues which can be displayed / reported

5.2.1.95. Max Tags

Identifier	0x7D
Access	Read and write
Data bytes	1
Data format	Byte
Data default	5
Description	Set the maximum number of tags which can be displayed / reported

5.2.2. Pan and Tilt Control Sub-System (ID 0x01)

5.2.2.1. Manual Control Source

Identifier 0x02
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command sets the data source used in the Pan and Tilt Manual Control mode

- 0x00 – Disabled Pan and Tilt demands are set to zero
- 0x01 – Rate Pan and Tilt demands are set to the manual rate demands (see data items 0x20 and 0x28)
- 0x02 – Joystick Pan and Tilt demands are controlled by the joystick

5.2.2.2. Deadband Mode

Identifier 0x03
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command sets the mode of Deadband compensation that is used

- 0x00 – Disabled No Deadband compensation is applied
- 0x01 – Min Rate The minimum rate demands are set by the Deadband compensation values (see data items 0x31 and 0x39)
- 0x02 – Rate Step The rate demands are increased by the Deadband compensation values (see data items 0x31 and 0x39)
- 0x03 – Deadband Rate demands less than the Deadband compensation values (see data items 0x31 and 0x39) are set to zero

5.2.2.3. Acquire Bleed Enable

Identifier 0x04
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command controls whether the initial pull to Boresight is controlled through the Azimuth and Elevation bleed rates (see 5.2.2.21 below and 5.2.2.24 below)

- 0x00 – Disabled No control is applied to the initial pull to Boresight
- 0x01 – Enabled The initial Target to Boresight error is reduced in a controlled manner, the rate of the pull to Boresight is controlled by items 0x32 and 0x3A below.

5.2.2.4. Platform Manual Joystick Mode[2]

Identifier 0x05
Access Read and write
Data bytes 1
Data format Byte
Data default 0x00
Description Controls how the scaling of the joystick demand is calculated in acquisition mode

- 0x00 – Scaled by Joystick Gain only
- 0x02 – Scaled by both Joystick Gain and Camera FOV

[2]Joystick Interface items whilst mapped will only be relevant when Joystick input interface is enabled in XML config.

5.2.2.5. Track Mode Azimuth Filter Gain

Identifier	0x10
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0 (0x00001000)
Description	This command sets the gain of the filter used to calculate the Azimuth rate demand in the Pan and Tilt Track Control Mode

5.2.2.6. Track Mode Azimuth Filter Parameter P0

Identifier	0x11
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0 (0x00001000)
Description	This command sets the P0 parameter of the filter used to calculate the Azimuth rate demand in the Pan and Tilt Track Control Mode

5.2.2.7. Track Mode Azimuth Filter Parameter P1

Identifier	0x12
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Description	This command sets the P1 parameter of the filter used to calculate the Azimuth rate demand in the Pan and Tilt Track Control Mode

5.2.2.8. Track Mode Azimuth Filter Parameter I1

Identifier	0x13
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Description	This command sets the I1 parameter of the filter used to calculate the Azimuth rate demand in the Pan and Tilt Track Control Mode

5.2.2.9. Track Mode Elevation Filter Gain

Identifier	0x18
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0 (0x00000000)
Description	This command sets the gain of the filter used to calculate the Elevation rate demand in the Pan and Tilt Track Control Mode

5.2.2.10. Track Mode Elevation Filter Parameter P0

Identifier	0x19
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0 (0x00000000)
Description	This command sets the P0 parameter of the filter used to calculate the Elevation rate demand in the Pan and Tilt Track Control Mode

5.2.2.11. Track Mode Elevation Filter Parameter P1

Identifier	0x1A
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Description	This command sets the P1 parameter of the filter used to calculate the Elevation rate demand in the Pan and Tilt Track Control Mode

5.2.2.12. Track Mode Elevation Filter Parameter I1

Identifier	0x1B
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Description	This command sets the I1 parameter of the filter used to calculate the Elevation rate demand in the Pan and Tilt Track Control Mode

5.2.2.13. Manual Azimuth Rate Demand

Identifier	0x20
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the Azimuth value output in the Pan and Tilt Manual Control Mode when the Manual Control Source (0x02) is set to Rate

5.2.2.14. Platform Manual Joystick Gain – Azimuth

Identifier	0x22
Access	Read and write
Data bytes	4
Data format	Fixed point
Data default	1.0
Description	Gain applied to Joystick Azimuth demand when in acquisition mode

5.2.2.15. Platform Aimpoint Offset Joystick Gain[3] – Azimuth

Identifier	0x23
Access	Read and write
Data bytes	4
Data format	Fixed point
Data default	1.0
Description	Gain applied to Joystick Azimuth demand when in tracking mode for Aimpoint offset

[3]Joystick Interface items whilst mapped will only be relevant when Joystick input interface is enabled in XML config.

5.2.2.16. Manual Elevation Rate Demand

Identifier	0x28
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the Elevation value output in the Pan and Tilt Manual Control Mode when the Manual Control Source (0x02) is set to Rate

5.2.2.17. Platform Manual Joystick Gain – Elevation

Identifier	0x2A
Access	Read and write
Data bytes	4
Data format	Fixed point
Data default	1.0
Description	Gain applied to Joystick Elevation demand when in acquisition mode

5.2.2.18. Platform Aimpoint Offset Joystick Gain – Elevation[4]

Identifier	0x2B
Access	Read and write
Data bytes	4
Data format	Fixed point
Data default	1.0
Description	Gain applied to Joystick Elevation demand when in tracking mode for Aimpoint offset

5.2.2.19. Azimuth Drift Compensation

Identifier	0x30
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the value used to compensate the Azimuth rate demand for pedestal drift

5.2.2.20. Azimuth Deadband Compensation

Identifier	0x31
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the value used to compensate the Azimuth rate demand for pedestal Deadband

[4]Joystick Interface items whilst mapped will only be relevant when Joystick input interface is enabled in XML config.

5.2.2.21. Azimuth Bleed Rate

Identifier	0x32
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.01
Data units	Fraction of the FOV per frame
Description	During initial acquisition of the target, the bleed rate limits the acceleration demanded by the platform outputs.

5.2.2.22. Elevation Drift Compensation

Identifier	0x38
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the value used to compensate the Elevation rate demand for pedestal drift

5.2.2.23. Elevation Deadband Compensation

Identifier	0x39
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.0 (0x00000000)
Data units	Milliradians per second
Description	This command sets the value used to compensate the Elevation rate demand for pedestal Deadband

5.2.2.24. Elevation Bleed Rate

Identifier	0x3A
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.01
Data units	Fraction of the FOV per frame
Description	During initial acquisition of the target, the bleed rate limits the acceleration demanded by the platform outputs.

5.2.2.25. Current Control Mode

Identifier	0x40
Access	Read only
Data bytes	1
Data format	Byte
Data default	0 (Manual)
Description	This value reports the current Pan and Tilt Control mode; the following data values are valid

- 0x00 – Manual Manual inputs are used to control the pan and tilt
- 0x01 – Track Tracking Object positions are used to control the pan and tilt
- 0x02 – Coast Historical Rates are used to control the pan and tilt

5.2.2.26. Azimuth Rate Demand

Identifier	0x42
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Milliradians per second - positive right
Description	This value reports the azimuth rate demand as calculated by the Pan and Tilt control process.

5.2.2.27. Elevation Rate Demand

Identifier	0x43
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Milliradians per second - positive up
Description	This value reports the elevation rate demand as calculated by the Pan and Tilt control process.

5.2.2.28. Line of Sight Calculation Mode

Identifier	0x44
Access	Read and write
Data bytes	1
Data format	Byte
Description	Determines how the supplied pan and tilt feedback will be used to calculate the line of sight (LOS) of the system. ● 0x00 – Pan and tilt feedback not used. ● 0x02 – Pan and tilt line of sight positions used. ● 0x03 – Pan and tilt rates used. If using the Command and Status protocol the Platform feedback Az/El Angle and/or rates with/with latency should all be in a single message.

5.2.2.29. Azimuth Line of Sight

Identifier	0x45
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliradians - positive right.
Data Range	+- 1000 π milliradians, input beyond this range is accepted but will be reduced (modulo) to this range)
Description	Write value should be the current azimuth line of sight of the pan and tilt platform. This data should be updated at video rates, or higher, if available and selected to be used. Read value is the azimuth line if sight calculated from the internal Platform feedback Filter, according to the choice of input selected in 5.2.2.28.

5.2.2.30. Elevation Line of Sight

Identifier	0x46
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliradians – positive up.
Data Range	+- 1000 π milliradians, input beyond this range is accepted but will be reduced (modulo) to this range)
Description	Write value should be the current elevation line of sight of the pan and tilt platform. This data should be updated at video rates, or higher, if available and selected to be used. Read value is the elevation line of sight calculated from the internal Platform feedback Filter, according to the choice of input selected in 5.2.2.28.

5.2.2.31. Line of Sight Latency

Identifier	0x47
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliseconds
Description	This value should represent the time between the line of sight measurements being taken and the data being sent to the video tracker.

5.2.2.32. Azimuth Rate Feedback

Identifier	0x48
Access	Write only
Data bytes	4
Data format	Fixed Point
Data units	Milliradians per second – positive right.
Description	Current azimuth rate of motion of the pan and tilt platform. This data should be updated at video rates, or higher, if available.

5.2.2.33. Elevation Rate Feedback

Identifier	0x49
Access	Write only
Data bytes	4
Data format	Fixed Point
Data units	Milliradians per second – positive up.
Description	Current elevation rate of motion of the pan and tilt platform. This data should be updated at video rates, or higher, if available.

5.2.2.34. Rate Feedback Latency

Identifier	0x4A
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Milliseconds
Description	This value should represent the time between the rate measurements being taken and the data being sent to the video tracker.

5.2.2.35. Platform Feedback Filter Reset

Identifier	0x4B
Access	Write only
Data bytes	1
Data format	Byte
Data default	0 (Disabled)
Description	This command is used reset the filter used to estimate the current LOS of the platform based on the supplied position or rate feedback.

5.2.2.36. Platform Aimpoint Offset Enable

Identifier	0x4C
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0 (Disabled)
Description	This command is used to control application of platform aimpoint offset which allows an operator to drive the closed loop track aimpoint away from the boresight so that the actual sensor boresight is aligned with a different part of the object. Aimpoint offsets are automatically cleared on exit from track mode. ●0x00 – Disabled – Aimpoint offsets cleared to 0 ●0x01 – Enabled – Aimpoint offsets may be updated with following controls ●0x02 – Enabled – Aimpoint offsets updated using Joystick source

5.2.2.37. Platform Increment Azimuth Aimpoint Offset

Identifier	0x4D
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Fraction of horizontal field of view. Positive values move the track gate to the right, negative left.
Description	Any value written to this parameter will be consumed and added to the applied offset after to the next image process cycle. The values applied here should be small enough for the tracker handle the target motion induced when moving the aimpoint around the Field of View. Typically, the increment should be limited to a maximum of +/- .04. The reported value will be cleared to 0.0 when it has been used by the system.

5.2.2.38. Platform Increment Elevation Aimpoint Offset

Identifier	0x4E
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Fraction of vertical field of view. Positive values move the track gate upwards negative downwards.
Description	Any value written to this parameter will be consumed and added to the applied offset after to the next image process cycle. The values applied here should be small enough for the tracker handle the target motion induced when moving the aimpoint around the Field of View. Typically, the increment should be limited to a maximum of +/- .04. The reported value will be cleared to 0.0 when it has been used by the system.

5.2.2.39. Platform Aimpoint Offset Delay

Identifier	0x4F
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	Seconds.
Description	The platform aimpoint offset is not applied during the platform aimpoint offset delay period. This gives time for the operator to release the joystick after driving the platform and entering track.

5.2.2.40. UDP Platform Interface Output Message Format

Identifier 0x50
Access Read and write
Data bytes 1
Data format Byte
Data default 0 Disabled
Description Select the format of the fixed format platform interface message (see 5.4.3 below)message output over Ethernet UDP interface

- 0x00 – Disabled No message output
- 0x01 – TBE (Pixels) Message with Target to Boresight errors in pixels
- 0x02 – TBE (Milliradians) Message with Target to Boresight errors in milliradians
- 0x03 – Rate Demands Message with platform demand in Milliradians per second
- 0x04 – Target Data Message with Target to Boresight errors in milliradians and target rate in milliradians per second
- 0x05 – Rate Demands Message with Target to Boresight errors in milliradians, target rate in milliradians per second and platform rate demand
- 0x07 – TBE and Rate Message with Target to Boresight errors in milliradians and reconstructed target position in milliradians

5.2.2.41. Serial Platform Interface Output Message Format

Identifier 0x51
Access Read and write
Data bytes 1
Data format Byte
Data default 4 (Enabled, tracked target with angular rate data)
Description Select the format of the fixed format platform interface message (see 5.4.3 below)message output over serial interface

- 0x00 – Disabled No message output
- 0x01 – TBE (Pixels) Message with Target to Boresight errors in pixels
- 0x02 – TBE (Milliradians) Message with Target to Boresight errors in milliradians
- 0x03 – Rate Demands Message with platform demand in Milliradians per second
- 0x04 – Target Data Message with Target to Boresight errors in milliradians and target rate in milliradians per second
- 0x05 – Rate Demands Message with Target to Boresight errors in milliradians, target rate in milliradians per second
- 0x07 – TBE and Rate Message with Target to Boresight errors in milliradians and reconstructed target position in milliradians

5.2.2.42. Closed Loop Control on Tagged Target

Identifier 0x52
Access Read and write
Data bytes 1
Data format Byte
Description Set the specified tagged target as the closed loop target.

- 0x00 Cancel closed loop control
- 0x01 – 0x05 Set the specified tagged target as the closed loop target

5.2.2.43. Closed Loop Control on First Track

Identifier 0x53
Access Read and write
Data bytes 1
Data format Byte
Description If there are no existing tagged targets, enabling this command will set the next tagged target to be the closed loop target. This item will be automatically reset following the next target tag

- 0x00 No change to closed loop target
- 0x01 Next tagged target will become the closed loop target

5.2.2.44. Platform Azimuth Aimpoint Offset

Identifier	0x54
Access	Read only
Data bytes	4
Data format	Fixed Point
Data Units	Fraction of horizontal field of view
Description	Provides feedback of the total aimpoint offset currently applied via the aimpoint offset increments from ID 0x4D

5.2.2.45. Platform Elevation Aimpoint Offset

Identifier	0x55
Access	Read only
Data bytes	4
Data format	Fixed Point
Data Units	Fraction of vertical field of view
Description	Provides feedback of the total aimpoint offset currently applied via the aimpoint offset increments from ID 0x4E

5.2.3. Video Output Sub-System (ID 0x02)

5.2.3.1. Enable Overlay

Identifier 0x00
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of all enabled symbology items. The symbology will be present on all available outputs.

- 0x00 Disabled
- 0x01 Enabled

5.2.3.2. Object Location Status Enable

Identifier 0x10
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the Object Location state text

- 0x00 Disabled
- 0x01 Enabled

5.2.3.3. Camera Status Enable

Identifier 0x12
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command is used to control display of the Camera status line which includes the current LOS and FOV

- 0x00 Disabled
- 0x01 Enabled

5.2.3.4. Object Location Status Position X

Identifier 0x13
Access Read and write
Data bytes 4
Data format Fixed
Units Percentage of display (0.0 .. 100.0)
Description Specify the horizontal location of the tracker status line (positive values relative to left edge, negative values relative to right edge)

5.2.3.5. Object Location Status Position Y

Identifier 0x14
Access Read and write
Data bytes 4
Data format Fixed
Units Percentage of display (0.0 .. 100.0)
Description Specify the vertical location of the tracker status line (positive values relative to top edge, negative values relative to bottom)

5.2.3.6. Detection Threshold Gauge Enable

Identifier 0x15
Access Read and write
Data bytes 1
Data format Byte
Description Determine whether the hot spot acquire threshold gauge is displayed

- 0x00 Disabled
- 0x01 Enabled

5.2.3.7. Detection Threshold Gauge Position X

Identifier 0x16
Access Read and write
Data bytes 4
Data format Fixed
Units Percentage of display (0.0 .. 100.0)
Description Specify the horizontal location of the hot spot acquire threshold gauge (positive values relative to left edge, negative values relative to right edge)

5.2.3.8. Detection Threshold Gauge Position Y

Identifier 0x17
Access Read and write
Data bytes 4
Data format Fixed
Units Percentage of display (0.0 .. 100.0)
Description Specify the vertical location of the hot spot acquire threshold gauge (positive values relative to top edge, negative values relative to bottom)

5.2.3.9. Object Location Area of Interest

Identifier 0x19
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the Object Location area of interest graphical symbology

- 0x00 Disabled
- 0x01 Enabled

5.2.3.10. Object Aimpoint

Identifier 0x1A
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the Object Aimpoint graphical symbology

- 0x00 Disabled
- 0x01 Enabled

5.2.3.11. Object Extents

Identifier 0x1B
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the Object Extents graphical symbology

- 0x00 Disabled
- 0x01 Enabled

5.2.3.12. Camera Boresight

Identifier 0x1C
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the Camera Boresight graphical symbology

- 0x00 Disabled
- 0x01 Enabled

5.2.3.13. Manual Track Window Size

Identifier 0x1E
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command is used to control display of the Manual Track Window Size graphical symbology

- 0x00 Disabled
- 0x01 Enabled

5.2.3.14. Other Targets

Identifier 0x20
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of secondary targets during Detection mode

- 0x00 Disabled
- 0x01 Enabled

5.2.3.15. Target Numeric Tags

Identifier 0x21
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of targets numeric tags during Detection mode

- 0x00 Disabled
- 0x01 Enabled

5.2.3.16. Pre-processed Video Display

Identifier 0x30
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the pre-processed video. When in Track mode, with the Correlation algorithm selected, the Correlation reference array is shown

- 0x00 Disabled
- 0x01 Enabled

5.2.3.17. Enable Image Stabilisation

Identifier 0x38
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to enable the electronic image stabilisation function

- 0x00 Disabled
- 0x01 Enabled

5.2.3.18. Enable Image Enhancement

Identifier 0x3A
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to enable the local area contrast image enhancement function

- 0x00 Disabled
- 0x01 Enabled

5.2.3.19. Shadow Symbology

Identifier 0x40
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control style of the symbology added to the processed video. When disabled, symbols are drawn in white only, when enabled, symbols are drawn in white with a black shadow.

- 0x00 Disabled
- 0x01 Enabled

5.2.3.20. Timestamp Enable

Identifier 0x44
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This command is used to control the display of timestamp information on the video output. Display of time and date are controlled independently by the upper and lower nibbles of the byte

- 0xX0 – Time display disabled
- 0xX1 – HH:MM:SS.sss
  0xX2 – SSSSSSSS.sss
  0xX3 – HH:MM:SS
  0xX4 – Incrementing frame count
  0x0Y – Date display disabled
  0x1Y – DD/MM/YY
  0x2Y – MM/DD/YY
  0x3Y – YY/MM/DD
  0x4Y – DD/MM/YYYY
  0x5Y – MM/DD/YYYY
  0x6Y – YYYY/MM/DD

5.2.3.21. IP Address Display

Identifier 0x46
Access Read and write
Data bytes 1
Data format Byte
Data default 1 (Enabled)
Description This command is used to control display of the IP Address banner.

- 0x00 Disabled
- 0x01 Enabled

5.2.3.22. Classifier Tag Enable

Identifier 0x47
Access Read and write
Data bytes 1
Data format Byte
Data default 0x00
Description Controls the display of the Target Classification class text label, which is only valid for systems with and running target Classification.

- 0x00 Disabled
- 0x01 Enabled

5.2.3.23. Classifier Prediction Area Enable

Identifier 0x48
Access Read and write
Data bytes 1
Data format Byte
Data default 0x00
Description Controls the display of the Target Classification Target size box, intended only as a diagnostic aid, and is only valid for systems with and running target Classification.

- 0x00 Disabled
- 0x01 Enabled

5.2.3.24. Timestamp Position X

Identifier	0x49
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	85%
Description	Specify the horizontal location of the timestamp (percentage of the display 0.0 .. 100.0 – positive values relative to the left edge, negative values relative to the right edge)

5.2.3.25. Timestamp Position Y

Identifier	0x4A
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	95%
Description	Specify the vertical location of the timestamp (percentage of the display 0.0 .. 100.0 – positive values relative to the top edge, negative values relative to the bottom)

5.2.3.26. Camera Status Position X

Identifier	0x4B
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	5%
Description	Specify the horizontal location of the camera FOV and LOS (percentage of the display 0.0 .. 100.0 – positive values relative to the left edge, negative values relative to the right edge)

5.2.3.27. Camera Status Position Y

Identifier	0x4C
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	95%
Description	Specify the vertical location of the camera FOV and LOS (percentage of the display 0.0 .. 100.0 – positive values relative to the top edge, negative values relative to the bottom)

5.2.3.28. Video Status Display

Identifier	0x4D
Access	Read and write
Data bytes	1
Data format	Byte
Data default	1 (Enabled)
Description	This command is used to control display of the video status banner. Note that not all video inputs support this feature ● 0x00 Disabled ● 0x01 Enabled

5.2.3.29. Video Status Position X

Identifier	0x4E
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	5%
Description	Specify the horizontal location of the video status banner (percentage of the display 0.0 .. 100.0 – positive values relative to the left edge, negative values relative to the right edge)

5.2.3.30. Video Status Position Y

Identifier	0x4F
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	85%
Description	Specify the vertical location of the video status banner (percentage of the display 0.0 .. 100.0 – positive values relative to the top edge, negative values relative to the bottom)

5.2.4. Camera Sub-System (ID 0x03)

5.2.4.1. Video Input Channel

Identifier 0x11
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Channel 1)
Description This command is used to select the input video source that is used for processing

- 0x00 – Channel 1
- 0x01 – Channel 2
- 0x02 – Channel 3 (where available)
- 0x03 – Channel 4 (where available)

Note: If the resolution of the new channel is different to the current channel then the Boresight Position will need to be updated. See sections 5.2.4.4 and 5.2.4.5.

5.2.4.2. Horizontal FOV

Identifier 0x12
Access Read and write
Data bytes 4
Data format Fixed Point
Data units Milliradians
Data default 640.0 (0x00280000) – Typical value, but varies with camera
Description This command sets the horizontal FOV of the input video source

5.2.4.3. FOV Aspect Ratio

Identifier 0x13
Access Read and write
Data bytes 4
Data format Fixed Point
Data default 1.3333 (0x00001555) – Typical value, but varies with video format
Description This command sets ratio between the horizontal and vertical FOV of the input video source

5.2.4.4. Boresight Position X

Identifier 0x16
Access Read and write
Data bytes 2
Data format Unsigned Word
Data units Pixels, origin is top left of the processed video frame, positive is right
Data default 320 (0x0140) – Typical value, but varies with video format
Description This command is used to position the camera Boresight in the X axis

5.2.4.5. Boresight Position Y

Identifier 0x17
Access Read and write
Data bytes 2
Data format Unsigned Word
Data units Pixels, origin is top left of the processed video frame, positive is down
Data default 240 (0x00F0) – Typical value, but varies with video format
Description This command is used to position the camera Boresight in the Y axis

5.2.4.6. Image Processing Region Left Margin

Identifier	0x20
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels, origin is the left of the processed video frame, positive is right
Data default	8 (0x0008)
Description	This command is used to set the left hand extent of the input video region that shall not be processed by the Tracker

5.2.4.7. Image Processing Region Right Margin

Identifier	0x21
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels, origin is right of the processed video frame, positive is left
Data default	8 (0x0008)
Description	This command is used to set the right hand extent of the input video region that shall not be processed by the Tracker

5.2.4.8. Image Processing Region Top Margin

Identifier	0x22
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels, origin is top of the processed video frame, positive is down
Data default	8 (0x0008)
Description	This command is used to set the top extent of the input video region that shall not be processed by the Tracker

5.2.4.9. Image Processing Region Bottom Margin

Identifier	0x23
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data units	Pixels, origin is bottom of the processed video frame, positive is up
Data default	8 (0x0008)
Description	This command is used to set the bottom extent of the input video region that shall not be processed by the Tracker

5.2.4.10. Video Latency

Identifier	0x24
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data units	milli-seconds
Data default	0.0
Description	This command allows for adjustment to video timestamping

5.2.4.11. Current Input Video Status

Identifier	0x25
Access	Read only
Data bytes	1
Data format	Byte
Data units	None
Description	A read of this parameter will provide an indication of the status of the currently selected video input. ● 0 – No input video ● 1 – Input video present

5.2.4.12. All Input Video Status

Identifier	0x27
Access	Read only
Data bytes	1
Data format	Bit field
Data units	None
Description	A read of this parameter will provide an indication of the status of all the video inputs. The state of each video input is represented by the relevant bit in the 8-bit data word. ● 0 – No input video ● 1 – Input video present

5.2.4.13. Camera Command Parameter Type

Identifier	0x28
Access	Read and write
Data bytes	4
Data format	S32
Data default	0x00000000
Description	Sets the parameter to be written to or read from. Values are in IRBGRAB_DLL documentation in InfraTec SDK. For example, IRBG_PARAM_Focus_PosRel = 464.

5.2.4.14. Camera Command Parameter Data Type

Identifier	0x29
Access	Read and write
Data bytes	4
Data format	U32
Data default	0x00000000 (UINT32)
Description	Data format of parameter to be written to or read from InfraTec device. Can be one of the following values:

INT8	0x20000001
INT16	0x30000002
INT32	0x40000004
INT64	0x50000008
UINT8	0x60000001
UINT16	0x70000002
UINT32	0x80000004
UINT64	0x90000008
FLOAT32	0xA0000004
FLOAT64	0xB0000008

5.2.4.15. Camera Command Parameter Data

Identifier	0x2A
Access	Read and write
Data bytes	8
Data format	Depends on parameter type (see ID 0x27 above). Parameters requiring less than 8 bytes shall have most significant bytes zero padded to fill
Data default	0x00000000
Description	Reads or writes data to InfraTec device. Parameter Type & Data Type must be set before reading or writing. If data is less than 64bits it is right aligned. For example:

(UINT8) 42	= 0x000000000000002A
(INT32) -45	= 0x00000000FFFFFFD3
(UINT64) 4294967296	= 0x0000000100000000
(FLOAT32) 3.14	= 0x000000004048F5C3
(FLOAT64) 3.14	= 0x40091EB851EB851F

5.2.4.16. Camera Command Parameter Read/Write

Identifier	0x2B
Access	Read and write
Data bytes	1
Data format	Byte
Default	0x00
Description	This item is to provide control over when reads and writes happen to the InfraTec camera. To perform a read setup the values for items 0x28,0x29 & 0x2A then set 0x2B to 1. When reading 0x2B returns 0 the data has been read from the camera. For a write configure the data to be written and then set 0x2B to 2 reading 0x2B back will return 2 until the data has been written when 0 will be returned.

- 0x00 – idle (read/write complete)
- 0x01 – trigger read
- 0x02 – trigger write

5.2.4.17. Frame Count

Identifier	0x40
Access	Read only
Data bytes	4
Data format	Unsigned Integer
Description	Count of number of Video images processed since system powered on.

5.2.4.18. Primary Video Input Width

Identifier	0x43
Access	Read only
Data bytes	2
Data format	Unsigned Word
Data units	Pixels
Description	Width of the primary video input (Note not all video inputs support this feature)

5.2.4.19. Primary Video Input Height

Identifier	0x44
Access	Read only
Data bytes	2
Data format	Unsigned Word
Data units	Pixels
Description	Height of the primary video input (Note not all video inputs support this feature)

5.2.4.20. Primary Video Input Frame Rate

Identifier	0x45
Access	Read only
Data bytes	4
Data format	Fixed Point
Data units	Hz
Description	Frame rate of the primary video input (Note not all video inputs support this feature)

5.2.5. Synthetic Target Sub-System (ID 0x04)

5.2.5.1. Target Trajectory Mode

Identifier 0x00
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (disabled)
Description This command is used to select the trajectory mode for both targets

- 0x00 – Disabled
- 0x01 – Polar rate
- 0x03 – Cartesian
- 0x04 – Polar position

5.2.5.2. Background Intensity

Identifier 0x01
Access Read and write
Data bytes 1
Data format Byte
Data default 0 (Incoming Video)
Description This command is used to select the background intensity for the synthetic target mode.

- 0 Background is incoming video
- 1 – 255 Background intensity from black (1) to white (255)

5.2.5.3. High Resolution Intensity Mode

Identifier 0x03
Access Read and write
Data bytes 1
Data format Byte
Data default 0
Description This command is used to enable high resolution (i.e. 16-bit) intensities for the synthetic target mode when using Camera Link video input and should be disabled for any other video input. This command is only applicable to Vision4ce hardware platforms that support Camera Link video input.

- 0x00 Disabled
- 0x01 Enabled

5.2.5.4. High Resolution Background Intensity

Identifier 0x04
Access Read and write
Data bytes 2
Data format Unsigned Word
Data default 0 (Incoming Video)
Description This command is used to select the Camera Link high resolution background intensity for the synthetic target mode when using Camera Link video input. This command is only applicable to Vision4ce hardware platforms that support Camera Link video input.

- 0 Background is incoming video
- 1 – 65535 Background intensity from black (1) to white (65535)

5.2.5.5. Target Active

Identifier	0x10 (target 1) 0x30 (target 2)
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0 (disabled)
Description	This command is used to select the display state for each target

- 0x00 Disabled
- 0x01 Enabled

5.2.5.6. Target Intensity

Identifier	0x11 (target 1) 0x31 (target 2)
Access	Read and write
Data bytes	1
Data format	Byte
Data unit	Grey levels
Data default	0 (black)
Description	This command sets the intensity of each target

5.2.5.7. Polar Target Size X

Identifier	0x12 (target 1) 0x32 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians
Data default	20.0
Description	This command sets the horizontal size of each target

5.2.5.8. Polar Target Size Y

Identifier	0x13 (target 1) 0x33 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians
Data default	20.0
Description	This command sets the vertical size of each target

5.2.5.9. Polar Initial Position X

Identifier	0x14 (target 1) 0x34 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive to the right of the Boresight
Data default	20.0
Description	This command sets the initial horizontal position of each target centre

5.2.5.10. Polar Initial Position Y

Identifier	0x15 (target 1) 0x35 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive above the Boresight
Data default	20.0
Description	This command sets the initial vertical position of each target centre

5.2.5.11. Polar Initial Speed X

Identifier	0x16 (target 1) 0x36 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians per second, positive to the right
Data default	20.0
Description	This command sets the initial horizontal speed of each target (only applied in polar speed mode)

5.2.5.12. Polar Initial Speed Y

Identifier	0x17 (target 1) 0x37 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians per second, positive upwards
Data default	20.0
Description	This command sets the initial vertical speed of each target (only applied in polar speed mode)

5.2.5.13. Rate Mode Minimum Position X

Identifier	0x18 (target 1) 0x38 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive to the right of the Boresight
Data default	-100.0
Description	This command sets the minimum horizontal position of each target, the horizontal speed is negated when the centre of the target reaches this position (only applied in polar speed mode)

5.2.5.14. Rate Mode Minimum Position Y

Identifier	0x19 (target 1) 0x39 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive above the Boresight
Data default	-100.0
Description	This command sets the minimum vertical position of each target, the vertical speed is negated when the centre of the target reaches this position (only applied in polar speed mode)

5.2.5.15. Rate Mode Maximum Position X

Identifier	0x1A (target 1) 0x3A (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive to the right of the Boresight
Data default	100.0
Description	This command sets the maximum horizontal position of each target, the horizontal speed is negated when the centre of the target reaches this position (only applied in polar speed mode)

5.2.5.16. Rate Mode Maximum Position Y

Identifier	0x1B (target 1) 0x3B (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Milliradians, relative to image Boresight, positive above the Boresight
Data default	100.0
Description	This command sets the maximum vertical position of each target, the vertical speed is negated when the centre of the target reaches this position (only applied in polar speed mode)

5.2.5.17. High Resolution Target Intensity

Identifier	0x1C (target 1) 0x3C (target 2)
Access	Read and write
Data bytes	2
Data format	Unsigned Word
Data unit	Grey levels
Data default	0 (black)
Description	This command sets the high resolution intensity of each target when using Camera Link video input. This command is only applicable to Vision4ce hardware platforms that support Camera Link video input.

5.2.5.18. Cartesian Position East

Identifier	0x50 (target 1) 0x58 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Metres, relative to the camera position, positive along the 0 degree elevation, 90 degree azimuth angle
Data default	100.0
Description	This command sets the cartesian position of the centre of each target

5.2.5.19. Cartesian Position North

Identifier	0x51 (target 1) 0x59 (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Metres, relative to the camera position, positive along the 0 degree elevation, 0 degree azimuth angle
Data default	100.0
Description	This command sets the cartesian position of the centre of each target

5.2.5.20. Cartesian Position Altitude

Identifier	0x52 (target 1) 0x5A (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Metres, relative to the camera position, positive along the 90 degree elevation angle
Data default	100.0
Description	This command sets the cartesian position of the centre of each target

5.2.5.21. Cartesian Target Width

Identifier	0x53 (target 1) 0x5B (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Metres
Data default	100.0
Description	This sets the width of each target, as seen from the camera

5.2.5.22. Cartesian Target Height

Identifier	0x54 (target 1) 0x5C (target 2)
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data unit	Metres
Data default	100.0
Description	This sets the height of each target, as seen from the camera

5.2.6. Classifier Sub-System (ID 0x06)

5.2.6.1. Classifier Enable

Identifier	0x00
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0 (Disabled)
Description	This item controls if the classification engine should be loaded at application runtime.

- 0x00 – Disabled The classifier has not been enabled
- 0x01 – Enabled The classifier has been enabled

5.2.6.2. Minimum Confidence

Identifier	0x03
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	0.25
Description	This item controls the minimum confidence level to be reported from the classifier.

5.2.7. Video Encoding Sub-System (ID 0x07)

Only supported by the V4_EncMSDK Encoder, except Skipped Frames which is also supported by the V4_EncGst.

5.2.7.1. Encoder Codec

Identifier 0x00
Access Read only
Data bytes 1
Data format Byte
Data default 0 (Disabled)
Description This item reports the type of codec that is being used; the following data values are valid

- 0x00 – H.264 H.264 Codec is being used
- 0x01 – JPEG JPEG Codec is being used

5.2.7.2. H.264 Level[5]

Identifier 0x01
Access Read and write
Data bytes 1
Data format Byte
Data default 0x20 (Level 2.0)
Description This item controls the 'level' of H.264 codec being used; the following data values are valid

- 0x09 – Level 1b
- 0x10 – Level 1.0
- 0x11 – Level 1.1
- 0x12 – Level 1.2
- 0x13 – Level 1.3
- 0x20 – Level 2.0
- 0x21 – Level 2.1
- 0x22 – Level 2.2
- 0x30 – Level 3.0
- 0x31 – Level 3.1
- 0x32 – Level 3.2
- 0x40 – Level 4.0
- 0x41 – Level 4.1
- 0x42 – Level 4.2
- 0x50 – Level 5.0
- 0x51 – Level 5.1
- 0x52 – Level 5.2

5.2.7.3. H.264 Profile[6]

Identifier 0x02
Access Read and write
Data bytes 1
Data format Byte
Data default 0x01 (Main)
Description This item controls the 'profile' of the H.264 codec; the following data values are valid

- 0x00 – Baseline
- 0x01 – Main
- 0x02 – Extended
- 0x03 – High

[5] Only applies when the H.264 codec is in use.
[6] Only applies when the H.264 codec is in use.

5.2.7.4. Skipped Frames

Identifier	0x03
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0x00
Description	Number of frames skipped between each encoded frame.

5.2.7.5. Bit Rate

Identifier	0x07
Access	Read and write
Data bytes	4
Data format	U32
Data unit	Kilobytes per second
Data default	4000
Description	Bit rate for the V4_EncMSDK encoder when set to H.264.

5.2.7.6. Quality

Identifier	0x08
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0x80
Description	Quality for the V4_EncMSDK encoder when set to JPEG.

5.2.7.7. Enable

Identifier	0x09
Access	Read only
Data bytes	1
Data format	Byte
Data default	0x00
Description	Indicate if the V4_EncMSDK encoder is running. In this case *running* means the input is connected.

5.2.8. Video Recording Sub-System (ID 0x08)

5.2.8.1. Record Enable

Identifier	0x01
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0x00 (Disabled)
Description	This item controls the recording to disk of the encoded video frames ● 0x00 – Recording disabled ● 0x01 – Recording enabled

5.2.8.2. Recording Channel Name[7]

Identifier	0x02
Access	Read and write
Data bytes	Variable
Data format	String
Data default	'Ch0'
Description	This item controls the text that is pre-pended to the date and time when forming the recording file name.

5.2.8.3. Pre-record Buffer Size

Identifier	0x03
Access	Read and write
Data bytes	4
Data format	Fixed Point
Data default	1.0 (0x00001000)
Units	Seconds
Description	This item controls the number of frames kept in a rolling buffer to be used as the start of any initiated video recording. The actual number of frames stored will depend on the frame rate of the video input.

5.2.8.4. Recording Directory[8]

Identifier	0x04
Access	Read and write
Data bytes	Variable
Data format	String
Data default	''
Description	This item controls the directory used to store recordings from this recorder instance.

5.2.8.5. Available Disk Space

Identifier	0x05
Access	Read only
Data bytes	4
Data format	Fixed Point
Description	This item reports the space available for recording on the disk that includes the recording sub-directory path (see ID 0x04 above)
Units	GBytes (1024 x 1024 x 1024 Bytes)

[7] Changes to recording name do not affect files currently being recorded but will affect any recordings that are started after the command has been received.
[8] Changes to recording directory do not affect files currently being recorded but will affect any recordings that are started after the command has been received.

5.2.9. Video Streaming Sub-System (ID 0x09)

Only supported by the V4_StreamMpegTs library

5.2.9.1. Stream Protocol

Identifier	0x00
Access	Read only
Data bytes	1
Data format	Byte
Data default	0x00 (Mpeg-TS)
Description	This item controls the protocol used to send the encoded video in the output stream, the following values are valid • 0x00 – Mpeg-TS • 0x01 – RTSP

5.2.9.2. Stream Enable

Identifier	0x01
Access	Read and write
Data bytes	1
Data format	Byte
Data default	0x00 (Disabled)
Description	This item controls the output of the encoded video stream • 0x00 – Stream disabled • 0x01 – Stream enabled

5.2.9.3. Stream Target IP Address

Identifier	0x02
Access	Read Only
Data bytes	Variable
Data format	String
Data default	‘239.0.0.1’
Description	This item controls the IP address that the encoded video stream is sent to

5.2.9.4. Stream Target Port

Identifier	0x03
Access	Read Only
Data bytes	2
Data format	U16
Data default	9001
Description	This item controls the port that the encoded video stream is sent to

5.2.9.5. Stream Bound IP Address

Identifier	0x04
Access	Read Only
Data bytes	Variable
Data format	String
Data default	‘0.0.0.0’ (None)
Description	This item controls the IP address of the network adapter that the stream is sent from

5.2.9.6. Stream Host Port

Identifier	0x05
Access	Read Only
Data bytes	2
Data format	U16
Data default	9001
Description	This item controls the port that the encoded video stream is sent from

5.2.10. Video Display Sub-System (ID 0x0A)

5.2.10.1. Video Window Position X

Identifier	0x01
Access	Read and write
Data bytes	4
Data format	Fixed
Units	Percentage of display (0.0 .. 100.0)
Description	Specify the horizontal location of the video window within the current video display (positive values relative to left edge, negative values relative to right edge)

5.2.10.2. Video Window Position Y

Identifier	0x02
Access	Read and write
Data bytes	4
Data format	Fixed
Units	Percentage of display (0.0 .. 100.0)
Description	Specify the vertical location of the video window within the current video display (positive values relative to bottom edge, negative values relative to top)

5.2.10.3. Video Window Size X

Identifier	0x03
Access	Read and write
Data bytes	4
Data format	Fixed
Units	Percentage of display (0.0 .. 100.0)
Description	Specify the horizontal size of the video window as a percentage of the current video display

5.2.10.4. Video Window Size Y

Identifier	0x04
Access	Read and write
Data bytes	4
Data format	Fixed
Units	Percentage of display (0.0 .. 100.0)
Description	Specify the vertical size of the video window as a percentage of the current video display

5.2.10.5. Video Window Z Order

Identifier	0x05
Access	Read and write
Data bytes	1
Data format	Byte
Units	None
Description	Specify the Z order of this video window. Video windows are rendered in Z order, so windows with lower Z order will be drawn behind those with higher Z order.

5.2.10.6. Video Zoom

Identifier	0x06
Access	Read and write
Data bytes	4
Data format	Fixed
Default Value	1.0
Data Range	0.1 .. 10.0
Description	This value defines the zoom factor applied to the output image for display on the screen.

5.2.11. Video Input Gain and Offset Control Sub-System (ID 0x0B)

5.2.11.1. Operation Mode

Identifier 0x00
Access Read and write
Data bytes 1
Data format Byte
Description This item sets the operation mode of the IR camera gain and offset function

- 0x00 Bypass – most significant 8 bits of the received 16 bits are processed
- 0x02 Manual – user defined offset and gain are applied (see below)
- 0x03 Automatic – offset and gain are automatically calculated based on the input video

5.2.11.2. Manual Gain

Identifier 0x01
Access Read and write
Data bytes 4
Data format Fixed
Description Set the gain applied to input pixel intensity values when Manual operation mode is selected (see 5.2.11.1 above). When Automatic mode is selected this value reports the latest gain value calculated.

5.2.11.3. Manual Offset

Identifier 0x02
Access Read and write
Data bytes 2
Data format U16
Description Set the offset applied to input pixel intensity values when Manual operation mode is selected (see 5.2.11.1 above) When Automatic mode is selected this value reports the latest offset value calculated.

5.2.11.4. AGC Filter Alpha

Identifier 0x05
Access Read and write
Data bytes 4
Data format Fixed
Description Set alpha value used in the offset and gain filter used when Automatic operation is selected (see 5.2.11.1 above)

5.2.11.5. Pause AGC

Identifier 0x0A
Access Read and write
Data bytes 1
Data format Byte
Description Pause the Automatic operation, which will cause the offset and gain values to freeze at their current values

- 0x00 AGC calculates new offset and gain values on every video frame
- 0x01 AGC is paused, so offset and gain values remain constant

5.2.12. Electronic Stabilisation Sub-System (ID 0x0C)

5.2.12.1. Stabilisation Enable

Identifier 0x00
Access Read and write
Data bytes 1
Data format Byte
Data default 0x00 (Disabled)
Description This item controls whether the stabilisation function is enabled.

- 0x00 – Stabilisation disabled
- 0x01 – Stabilisation enabled

5.2.12.2. Stabilisation Parameters

Identifier 0x01
Access Read only
Data bytes 1
Data format Byte
Data default 0x02
Description This item reports the number of parameters used to warp the input image to form the stabilised image

- 0x02 – 2 parameters Translation only

5.2.12.3. Filter Stabilisation Warp

Identifier 0x02
Access Read and write
Data bytes 1
Data format Byte
Data default 0x00 (Disabled)
Description This item controls whether the output warp from the electronic stabilisation is filtered (see section 4.3 above).

- 0x00 – Filtering disabled
- 0x01 – Filtering enabled

5.2.12.4. Reset Stabilisation Warp

Identifier 0x03
Access Write only
Data bytes 1
Data format Byte
Description Writing 0x01 to this item resets the current stabilisation warp to an identity warp

5.2.12.5. Digital Zoom

Identifier 0x04
Access Read and write
Data bytes 4
Data format Fixed
Data default 1.1
Units Fractional
Description This value defines the digital zoom factor applied to input image, prior to the application of the stabilisation warp, reduce the occurrence of black borders in the output image

5.2.12.6. X axis Border

Identifier	0x08
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.1
Units	Fractional
Description	This value defines a border area of the input image, in the horizontal axis, which is not included in the calculation of the frame to frame image movement

5.2.12.7. Y axis Border

Identifier	0x09
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.1
Units	Fractional
Description	This value defines a border area of the input image, in the vertical axis, which is not included in the calculation of the frame to frame image movement

5.2.12.8. Stabilise Alpha

Identifier	0x10
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.95
Description	Used as a multiplier to calculate the magnitude of stabilisation relaxation factor during the stabilise state

5.2.12.9. Slew Alpha

Identifier	0x11
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.6
Description	Used as a multiplier to calculate the magnitude of stabilisation relaxation factor during the slew state

5.2.12.10. Relax Alpha

Identifier	0x12
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.995
Description	Set the alpha value used to control the rate at which the relaxation factor changes from the slew to stabilise state and vice versa

5.2.12.11. Slew Magnitude

Identifier	0x13
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	400.0
Description	Set the warp magnitude at which the stabilisation switches between slew and stabilise states

5.2.13. Detected Target List Sub-System (0x1D)

This sub system is optional.

5.2.13.1. Target ID

Identifier	0x00 – Target 1, 0x10 – Target 2, 0x20 - Target 3, 0x30 – Target 4, 0x40 – Target 5
Access	Read only
Data bytes	4
Data format	U32
Range	0..255
Description	Track identification number

5.2.13.2. Target Status

Identifier	0x01 – Target 1, 0x11 – Target 2, 0x21 - Target 3, 0x31 – Target 4, 0x41 – Target 5
Access	Read only
Data bytes	1
Data format	BYTE
Description	This value reports the target status • 0x00 No target • 0x01 Target detected • 0x02 Target coasting

5.2.13.3. Target Position - X

Identifier	0x02 – Target 1, 0x12 – Target 2, 0x22 - Target 3, 0x32 – Target 4, 0x42 – Target 5
Access	Read only
Data bytes	4
Data format	Fixed
Data units	Pixels, origin is the Camera Boresight, positive is right
Description	This value reports the X axis location of the object Aimpoint

5.2.13.4. Target Position - Y

Identifier	0x03 – Target 1, 0x13 – Target 2, 0x23 - Target 3, 0x33 – Target 4, 0x43 – Target 5
Access	Read only
Data bytes	4
Data format	Fixed
Data units	Pixels, origin is the Camera Boresight, positive is up
Description	This value reports the Y axis location of the object Aimpoint

5.2.13.5. Target Size - X

Identifier	0x04 – Target 1, 0x14 – Target 2, 0x24 - Target 3, 0x34 – Target 4, 0x44 – Target 5
Access	Read only
Data bytes	4
Data format	Fixed
Data units	Pixels
Description	This value reports the width of the object

5.2.13.6. Target Size - Y

Identifier	0x05 – Target 1, 0x15 – Target 2, 0x25 - Target 3, 0x35 – Target 4, 0x45 – Target 5
Access	Read only
Data bytes	4
Data format	Fixed
Data units	Pixels
Description	This value reports the height of the object

5.2.14. Image Fusion Sub-System (0x70)

This sub system is optional.

5.2.14.1. Fusion Mode

Identifier	0x00
Access	Read and write
Data bytes	1
Data format	Enum
Data default	0x00 - Additive Fusion
Description	This command is used to select between different possible image fusion modes.

- 0x00 – Additive - a simple percentage blend
- 0x01 – Multi-resolution - aims to maintain detail from both images
- 0x02 – Bypass - No image fusion, output channel 1

5.2.14.2. Fusion Weight

Identifier	0x01
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.5
Description	Sets the blending weight used. 1.0 means all input 1, 0.5 is a 50:50 blend, 0.0 means all input 2

5.2.14.3. Fusion Source 1

Identifier	0x02
Access	Read and write
Data bytes	1
Data format	Enum
Data default	1 - Input 1
Description	Defines which of the four possible video inputs are used for image fusion source 1. A value of 0 means that the input will match the input being processed by the video tracker

5.2.14.4. Fusion Source 2

Identifier	0x03
Access	Read and write
Data bytes	1
Data format	Enum
Data default	2 - Input 2
Description	Defines which of the four possible video inputs are used for image fusion source 2. A value of 0 means that the input will match the input being processed by the video tracker

5.2.14.5. Input Warp - Centre of Rotation X

Identifier	0x10 - Input 1, 0x20 - Input 2, 0x30 - Input 3, 0x40 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.5
Range	0.0 .. 1.0
Description	Sets the centre of rotation

5.2.14.6. Input Warp - Centre of Rotation Y

Identifier	0x11 - Input 1, 0x21 - Input 2, 0x31 - Input 3, 0x41 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.5
Range	0.0 .. 1.0
Description	Sets the centre of rotation

5.2.14.7. Input Warp - Pre-Rotation Scale X

Identifier	0x12 - Input 1, 0x22 - Input 2, 0x32 - Input 3, 0x42 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.14.8. Input Warp - Pre-Rotation Scale Y

Identifier	0x13 - Input 1, 0x23 - Input 2, 0x33 - Input 3, 0x43 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.14.9. Input Warp - Rotation

Identifier	0x14 - Input 1, 0x24 - Input 2, 0x34 - Input 3, 0x44 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-360.0 .. 360.0
Description	Used to apply a rotation about the centre of rotation

5.2.14.10. Input Warp - Post-Rotation Scale X

Identifier	0x15 - Input 1, 0x25 - Input 2, 0x35 - Input 3, 0x45 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.14.11. Input Warp - Post-Rotation Scale Y

Identifier	0x16 - Input 1, 0x26 - Input 2, 0x36 - Input 3, 0x46 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.14.12. Input Warp - Translation X

Identifier	0x17 - Input 1, 0x27 - Input 2, 0x37 - Input 3, 0x47 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-0.5 .. 0.5
Description	Sets the final image translation

5.2.14.13. Input Warp - Translation Y

Identifier	0x18 - Input 1, 0x28 - Input 2, 0x38 - Input 3, 0x48 - Input 4
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-0.5 .. 0.5
Description	Sets the final image translation

5.2.15. Image Warp Sub-System (0x71)

This sub system is optional.

5.2.15.1. Enable Warp

Identifier	0x00
Access	Read and write
Data bytes	1
Data format	Bool
Data default	0x00 - Disabled
Description	This command is used to control whether the image warp function is enabled ● 0x00 – Disabled ● 0x01 – Enabled

5.2.15.2. Input 1 Warp - Centre of Rotation X

Identifier	0x01
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.5
Range	0.0 .. 1.0
Description	Sets the centre of rotation

5.2.15.3. Input 1 Warp - Centre of Rotation Y

Identifier	0x02
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.5
Range	0.0 .. 1.0
Description	Sets the centre of rotation

5.2.15.4. Input 1 Warp - Pre-Rotation Scale X

Identifier	0x03
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.15.5. Input 1 Warp - Pre-Rotation Scale Y

Identifier	0x04
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.15.6. Input 1 Warp - Rotation

Identifier	0x05
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-360.0 .. 360.0
Description	Used to apply a rotation about the centre of rotation

5.2.15.7. Input 1 Warp - Post-Rotation Scale X

Identifier	0x06
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.15.8. Input 1 Warp - Post-Rotation Scale Y

Identifier	0x07
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	1.0
Range	0.1 .. 10.0
Description	Used to apply image scaling prior to rotation

5.2.15.9. Input 1 Warp - Translation X

Identifier	0x08
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-0.5 .. 0.5
Description	Sets the final image translation

5.2.15.10. Input 1 Warp - Translation Y

Identifier	0x09
Access	Read and write
Data bytes	4
Data format	Fixed
Data default	0.0
Range	-0.5 .. 0.5
Description	Sets the final image translation

5.2.16. Tracked Target Sub-System (ID 0x8X)

If the system allows concurrent cue and tag mode and this mode is enabled, the tracked target sub-systems provide feedback of the target position and size as well as control of some of the tracking parameters. The Tracked Target sub-systems use a subset of the data items available in the Object Location sub-system 0x00. Refer to section 5.2.1 for details of the item data types.

Note: Control of the cueing parameters is always available through the Object Location sub-system 0x00.

The following mapping applies between tagged target windows and sub-system IDs.

Tagged Target Window ID	Sub-System ID
1	0x80
2	0x81
3	0x82
4	0x83
5	0x84

The following table lists parameters which are available in the Object Location sub-system and shows the subset supported by the Tracked Target sub-systems.

Parameter	Identifier	Object Location Sub-System (0x00)	Tracked Target Sub-Systems (0x80 – 0x84)	Comments
Object Tracking Mode	0x00	✓	✓	0x00 – Disable 0x02 – Force Coast
Automatic Tracking Mode Selection	0x01	✓		
Automatic Tracking Mode Delay	0x02	✓		
Tracking Coast Duration	0x03	✓		Coast time for all tags is specified by subsystem 0x00
Detection Priority Metric	0x04	✓		
Detection Target Polarity	0x05	✓		
Tracking Aimpoint Bias	0x06	✓	✓	Initialised from subsystem 0x00
Auto Tracking Arm Mode	0x0B	✓		
Object Detection Algorithm	0x0E	✓		
Object Track Algorithm	0x0F	✓	✓	Initialised from subsystem 0x00
Detection Area of Interest Position X	0x10	✓		
Detection Area of Interest Position Y	0x11	✓		
Detection Area of Interest Size X	0x12	✓		
Detection Area of Interest Size Y	0x13	✓		
Track Area of Interest Size Adjustment X	0x15	✓	✓	
Track Area of Interest Size Adjustment Y	0x16	✓	✓	
Track Area of Interest Position Adjustment X	0x17	✓	✓	
Track Area of Interest Position Adjustment Y	0x18	✓	✓	

Parameter	Identifier	Object Location Sub-System (0x00)	Tracked Target Sub-Systems (0x80 – 0x84)	Comments
Object Tracking Quality Threshold	0x20	✓	✓	
Object Tracking Model Update Alpha	0x25	✓		
Object Tracking Prediction	0x26	✓		
Object Tracking Prediction Alpha	0x27	✓		
Track List Output Enable	0x28	✓		
Track List Output Format	0x29	✓		
Track List Output Hysteresis	0x2A	✓		
Object Tracking Mode by Detect Track Id	0x2B	✓	✓	Transfer specified cue to this TAG[9]
Detected Object Minimum Size X	0x30	✓		
Detected Object Minimum Size Y	0x31	✓		
Detected Object Minimum Area	0x32	✓		
Detected Object Maximum Size X	0x33	✓		
Detected Object Maximum Size Y	0x34	✓		
Detected Object Maximum Area	0x35	✓		
Manual Detection uses Track Algorithm	0x36	✓		
Primary Object Status	0x40	✓	✓	
Primary Object Position X	0x42	✓	✓	
Primary Object Position Y	0x43	✓	✓	
Primary Object Size X	0x44	✓	✓	
Primary Object Size Y	0x45	✓	✓	
Primary Object Rate X	0x46	✓	✓	
Primary Object Rate Y	0x47	✓	✓	
Automatic Track Window Size	0x54	✓		
Manual Track Window Size X	0x55	✓		
Manual Track Window Size Y	0x56	✓		
BIT Warnings	0x68	✓		
BIT Errors	0x69	✓		
BIT Warning Test	0x6A	✓		
BIT Error Test	0x6B	✓		
Periodic Message Frequency	0x70	✓		
Periodic Message Contents Definition	0x71	✓		
S/W Major Version Number	0x72	✓		
S/W Minor Version Number	0x73	✓		
S/W Major Revision Number	0x74	✓		

✓ = Supported

- Comments
  - Target data output messages generated as soon as data is available
    - All tags will be output in a single message, see §5.5
  - Tracked target processing has higher priority than cue window processing

[9] If the tag is currently active the existing tag will be dropped and replaced by the new target

5.3. Command and Status Protocol Example Messages

5.3.1. Example 1 – Set detection area of interest position

Byte	Value	Notes
0	0x10	Header
1	0x00	Sub-system ID - Object Location Sub-System
2	0x00	Reserved
3	0x06	Data Length
4	0x10	Data element ID – Detection Area of Interest Position X
5	0x00	(Signed Word) +200
6	0xC8	
7	0x11	Data element ID – Detection Area of Interest Position Y
8	0xFF	(Signed Word) -100
9	0x9C	
10	0x9A	Checksum (0x10 + 0x00 + 0x00 + 0x06 + 0x10 + 0x00 + 0xC8 + 0x11 + 0xFF + 0x9C = 0x29A. Checksum is last byte)

```
10:00:00:06:10:00:C8:11:FF:9C:9A
```

Response:

Byte	Value	Notes
0	0x10	Header
1	0x00	Sub-system ID - Object Location Sub-System
2	0x00	Status
3	0x00	Data Length
4	0x10	Checksum

```
10:00:00:00:10
```

5.3.2. Example 2 – Request primary object status and position

Byte	Value	Notes
0	0x10	Header
1	0x00	Sub-system ID - Object Location Sub-System
2	0x00	Reserved
3	0x03	Data Length
4	0xC0	Data element ID – Primary Object Status (0x40 + 0x80 to indicate read)
5	0xC2	Data element ID – Primary Object Position X (0x42 + 0x80 to indicate read)
6	0xC3	Data element ID – Primary Object Position Y (0x43 + 0x80 to indicate read)
7	0x58	Checksum (0x10 + 0x00 + 0x00 + 0x03 + 0xC0 + 0xC2 + 0xC3 = 0x258. Checksum is last byte)

```
10:00:00:03:C0:C2:C3:58
```

Response:

Byte	Value	Notes
0	0x10	Header
1	0x00	Sub-system ID - Object Location Sub-System
2	0x00	Status
3	0x0C	Data Length
4	0x40	Data element ID – Primary Object Status
5	0x01	(Byte) Object Valid
6	0x42	Data element ID – Primary Object Position X
7	0x00	(Fixed) +100.0 0x00064000 in fixed point where first 20 bits (0x00064) are integer part and final 12 bits (0x000) are fractional part.
8	0x06	
9	0x40	

Byte	Value	Notes
10	0x00	
11	0x43	Data element ID – Primary Object Position Y
12	0xFF	(Fixed) -50.75
13	0xFC	
14	0xD4	0xFFFCD400 in fixed point where first 20 bits (0xFFFCD = -51) are integer part and final 12 bits (0x400 = +0.25) are fractional part.
15	0x00	
16	0xF7	Checksum (0x10 + 0x00 + 0x00 + 0x0C + 0x40 + 0x01 + 0x42 + 0x00 + 0x06 + 0x40 + 0x01 + 0x00 + 0x43 + 0xFF + 0xFC + 0xD4 + 0x00 = 0x3F7. Checksum is last byte)

10:00:00:0C:40:01:42:00:06:40:00:43:FF:FC:D4:00:F7

5.3.3. Example 3 – Request periodic status definition update

Byte	Value	Notes			
0	0x10	Header			
1	0x00	Sub-system ID - Object Location Sub-System			
2	0x00	Reserved			
3	0x11	Data Length			
4	0x71	Data Element ID – Periodic Message Contents (next 16 bytes)			
5	0x0B	Bits 0 – 7	0000 1011	0 1 3	0x00 Object Tracking Mode 0x01 Automatic Tracking Mode Selection 0x03 Tracking Coast Duration
6	0xC0	Bits 8 – 15	1100 0000	14 15	0x0E Object Detection Algorithm 0x0F Object Track Algorithm
7	0x0C	Bits 16 – 23	0000 1100	18 19	0x12 Detection Area of Interest Size X 0x13 Detection Area of Interest Size Y
8	0x00	Bits 24 – 31	0000 0000		No Items requested from this range
9	0x00	Bits 32 – 39	0000 0000		No Items requested from this range
10	0x00	Bits 40 – 47	0000 0000		No Items requested from this range
11	0x00	Bits 48 – 55	0000 0000		No Items requested from this range
12	0x00	Bits 56 – 63	0000 0000		No Items requested from this range
13	0x0D	Bits 64 – 71	0000 1101	64 66 67	0x40 Primary Object Status 0x42 Primary Object Position X 0x43 Primary Object Position Y
14	0x00	Bits 72 – 79	0000 0000		No Items requested from this range
15	0x00	Bits 80 – 87	0000 0000		No Items requested from this range
16	0x00	Bits 88 – 95	0000 0000		No Items requested from this range
17	0x00	Bits 96 – 103	0000 0000		No Items requested from this range
18	0x00	Bits 104 – 111	0000 0000		No Items requested from this range
19	0x00	Bits 112 – 119	0000 0000		No Items requested from this range
20	0x00	Bits 120 – 127	0000 0000		No Items requested from this range
21	0x76	Checksum (last byte of sum 0x0176)			

10:00:00:11:71:0B:C0:0C:00:00:00:00:00:0D:00:00:00:00:00:00:00:76

Response:

Byte	Value	Notes
0	0x10	Header
1	0x00	Sub-system ID - Object Location Sub-System
2	0x40	Message Origin – Periodic Status Message
3	0x1F	Data Length
4	0x00	Data Element ID – Object Tracking Mode
5	0x01	(Byte) Enabled
6	0x01	Data Element ID – Automatic Tracking Mode Selection
7	0x00	(Byte) Disabled
8	0x03	Data Element ID – Tracking Coast Duration
9	0x00	(Fixed) 2.0

Byte	Value	Notes
10	0x00	
11	0x20	
12	0x00	
13	0x0E	Data Element ID – Object Detection Algorithm
14	0x03	(Byte) Naval
15	0x0F	Data Element ID – Object Track Algorithm
16	0x01	(Byte) Correlation
17	0x12	Data Element ID – Detection Area of Interest Size X
18	0x01	(Signed Word) 320
19	0x40	
20	0x13	Data Element ID – Detection Area of Interest Size Y
21	0x00	(Signed Word) 240
22	0xF0	
23	0x40	Data Element ID – Primary Object Status
24	0x01	(Byte) Valid
25	0x42	Data Element ID – Primary Object Position X
26	0x00	(Fixed) +100.0
27	0x06	
28	0x40	
29	0x00	
30	0x43	Data Element ID – Primary Object Position Y
31	0xFF	(Fixed) -50.75
32	0xFC	
33	0XD4	
34	0x00	
35	0xE6	Checksum (0x05E6)

```
10:00:40:1F:00:01:01:00:03:00:00:20:00:0E:03:0F:01:12:01:40:13:00:F0:40:01:42:
00:06:40:00:43:FF:FC:D4:00:E6
```

5.4. Platform Interface Protocol

5.4.1. Protocol Overview

The platform protocol is designed for efficient communication of data between the FrameWorkx device and a servo platform and contains a number of fixed format messages. Each configuration group within the FrameWorkx application can have up to one instance of the Platform Interface Protocol running.

5.4.2. Physical

Platform Protocol messages can be communicated through the Ethernet or serial ports on the FrameWorkx device.

Ethernet Transport Protocol: UDP
Ethernet Port Number: 9874 (Default for receive data)

The protocol starts transmitting platform interface output messages following receipt of any UDP message on this Ethernet port. The output messages are sent to the IP address of the received message.

5.4.3. Output Message Format

The format of output message set through Control interface ‘Platform Interface Output Message Format’ item, see section 5.2.2.40.

Note: Target data applies to the closed loop target only

5.4.3.1. Tracked Target to Boresight Error (Pixels)

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25

Offset	Length (Bytes)	Format or Value	Description
1	2	U16	Message Length (total number of bytes)
3	1	0x01	Data Type – 0x01 is TBE in Pixels
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Target to Boresight Error X Axis (Pixels)
9	4	FIXED	Target to Boresight Error Y Axis (Pixels)
13	4	FIXED	Data latency estimate (Milliseconds)
17	1	BYTE	Modulo 256 sum of bytes 0 to 16

5.4.3.2. Tracked Target to Boresight Error (Milliradians)

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x02	Data Type – 0x02 is TBE in Milliradians
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Target to Boresight Error X Axis (Milliradians)
9	4	FIXED	Target to Boresight Error Y Axis (Milliradians)
13	4	FIXED	Data latency estimate (Milliseconds)
17	1	BYTE	Modulo 256 sum of bytes 0 to 16

5.4.3.3. Rate Demands

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x03	Data Type – 0x03 is platform rate demands
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Platform Rate Demand X Axis (Milliradians per second)
9	4	FIXED	Platform Rate Demand Y Axis (Milliradians per second)
13	4	FIXED	Data latency estimate (Milliseconds)
17	1	BYTE	Modulo 256 sum of bytes 0 to 16

5.4.3.4. Tracked Target with Rate Angular Data

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x04	Data Type – 0x04 is Angular TBE with rates
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Target to Boresight Error X Axis (Milliradians)
9	4	FIXED	Target to Boresight Error Y Axis (Milliradians)
13	4	FIXED	Target Rate X Axis (Milliradians per second)
17	4	FIXED	Target Rate Y Axis (Milliradians per second)
21	4	FIXED	Data latency estimate (Milliseconds)
25	1	BYTE	Modulo 256 sum of bytes 0 to 24

5.4.3.5. Tracked Target with Rate Angular Data and Rate Demands

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)

Offset	Length (Bytes)	Format or Value	Description
3	1	0x05	Data Type – 0x05 is Angular TBE with rates and platform demand
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Target to Boresight Error X Axis (Milliradians)
9	4	FIXED	Target to Boresight Error Y Axis (Milliradians)
13	4	FIXED	Target Rate X Axis (Milliradians per second)
17	4	FIXED	Target Rate Y Axis (Milliradians per second)
21	4	FIXED	Platform Rate Demand X Axis (Milliradians per second)
25	4	FIXED	Platform Rate Demand Y Axis (Milliradians per second)
29	4	FIXED	Data latency estimate (Milliseconds)
33	1	BYTE	Modulo 256 sum of bytes 0 to 32

5.4.3.6. Tracked Target Error and Position

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x07	Data Type – 0x07 is TBE and reconstructed target position
4	1	BYTE	Tracker Status (Acquire, Track, Coast)
5	4	FIXED	Target to Boresight Error X Axis (Milliradians)
9	4	FIXED	Target to Boresight Error Y Axis (Milliradians)
13	4	FIXED	Reconstructed Target Position X (Milliradians, range +/- 1000 π)
17	4	FIXED	Reconstructed Target Position X (Milliradians, range +/- 1000 π)
21	4	FIXED	Data latency estimate (Milliseconds)
25	1	BYTE	Modulo 256 sum of bytes 0 to 24

5.4.4. Input Message Format

The platform feedback data used by the tracker is set through the Control interface ‘Line of Sight Calculation Mode’ item, see section 5.2.2.28.

5.4.4.1. Line of Sight Data

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x01	Data Type – 0x01 is Platform Position
4	4	FIXED	Line of Sight X Axis (Milliradians, range +- 1000 π, input beyond this range is accepted but will be reduced (modulo) to this range)
8	4	FIXED	Line of Sight Y Axis (Milliradians, range +- 1000 π, input beyond this range is accepted but will be reduced (modulo) to this range)
12	4	FIXED	Data latency estimate (Milliseconds)
16	1	BYTE	Modulo 256 sum of bytes 0 to 15

5.4.4.2. Platform Rate Data

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x02	Data Type – 0x02 is Platform Rate
4	4	FIXED	Platform Rate X Axis (Milliradians per second)
8	4	FIXED	Platform Rate Y Axis (Milliradians per second)
12	4	FIXED	Data latency estimate (Milliseconds)

Offset	Length (Bytes)	Format or Value	Description
16	1	BYTE	Modulo 256 sum of bytes 0 to 15

5.4.4.3. Line of Sight and Rate Data

Offset	Length (Bytes)	Format or Value	Description
0	1	BYTE	Header - 0x25
1	2	U16	Message Length (total number of bytes)
3	1	0x03	Data Type – 0x03 is Platform Position and Rate
4	4	FIXED	Line of Sight X Axis (Milliradians, range +- 1000 π, input beyond this range is accepted but will be reduced (modulo) to this range)
8	4	FIXED	Line of Sight Y Axis (Milliradians, range +- 1000 π, input beyond this range is accepted but will be reduced (modulo) to this range)
12	4	FIXED	Platform Rate X Axis (Milliradians per second)
16	4	FIXED	Platform Rate Y Axis (Milliradians per second)
20	4	FIXED	Data latency estimate (Milliseconds)
24	1	BYTE	Modulo 256 sum of bytes 0 to 23

5.5. Track List Output Protocol

5.5.1. Protocol Overview

The track list output protocol is designed for efficient communication of data between the video tracking function of the FrameWorkx device and a consumer of cue (detected objects) and tag (tracked targets) status information. Each configuration group within the FrameWorkx application can have up to one instance of the Track List Output Protocol running.

5.5.2. Physical

Track List Protocol messages can be communicated through the Ethernet or serial ports on the FrameWorkx device.

Ethernet Transport Protocol: UDP
Ethernet Port Number: 9886 (Receive data)

The protocol starts transmitting output messages following receipt of any UDP message on this Ethernet port. The output messages are sent to the IP address of the received message.

5.5.3. Cue and Tag Message Output

When concurrent cue and track is enabled (subsystem 0x00, ID 0x75, §5.2.1.87) separate Track list messages will be output for:

- Tagged targets
- Cue targets

When concurrent cue and track is enabled, the Tracker may provide Cue Tracks from the Object Detection function while also concurrently maintaining multiple Tag Tracks, each with their own local object track.

A Cue Track List will be output, potentially providing multiple Cues until the maximum number of targets have been concurrently tagged when the Cue List becomes empty.

A Tag Track List is available which holds information on one or more tagged targets. When a track in the Cue list is promoted to a Tag Target, the Track information is no longer reported in the Cue List but in the Tag List.

The ordering of entries in the Cue List is dependent upon the Detection Priority Metric, and every Cue target has a unique Target Identifier. This Track Identifier is carried over into the Tag Track when the object is ‘tagged’.

Upon promotion from Cue to Tag, the track will be removed from the Cue List and reported in the first available slot in the Track List.

5.5.4. Classification

5.5.4.1. Operation

Classification is performed by a Convolution Neural Network (CNN) the network is configured to identify a single class of objects e.g. drones. The classification process is run over a 416 x 416 pixel region of the input video stream. The region is centred on the primary target as identified by the Target Detection and Tracking process

5.5.4.2. Outputs

The output list is matched with the current outputs from the Target Detection and Tracking process, so that cues and tags that match with classifier predictions are labelled with the class of the predictions.

5.5.5. Message Format

The track list message shall contain position data for the highest priority cues or tags that are currently active, i.e. it is a section of the current track list. The maximum number of tracks output shall be controlled through the Command and Status Communication Protocol, see 5.2.1.33 above. The track list messages shall have the following format.

Offset	Length (Bytes)	Format or Value	Description
0	1	0x77	Header Byte
1	1	BYTE	Message ID 0x07 - Cue object message 0x08 – Tagged target message 0x09 – Classifier message
2	2	U16	Message Length (total number of bytes)
4	1		Track Data format (see 5.5.6 below)
5	8	S64	Time of the track data (Unix time, microseconds since 1/1/1970)
13	1	BYTE	Number of tracks
14	N		Multiple track data sets in the selected track data format
N+14	1	BYTE	Modulo 256 sum of bytes 0 to N + 13

Note that data for all targets in a single message will be output in the same track data format.

5.5.6. Track Data Format

A number of track data formats are supported. The output track data format can be controlled through the Command and Status Communication Protocol, see 5.2.1.30 above. Each output track list indicates the track data format contained within the message through the ‘track data format’ byte (see above).

The supported track data formats are detailed below.

5.5.6.1. Track identification number

All track data formats include a track identification number. The track identification number includes 2 components, the Tag Number, and the Track Number. Cue tracks (detected objects) shall be output with a Tag number of 0.

Byte	1	2	3	4
Value	Tag Number (1 to 5 [10])	Track Number (1 to 255[11])		

5.5.6.2. Format 0x1E - Image Relative Coordinates

Offset	Length (Bytes)	Format or Value	Units	Description
0	4	U32	-	Track identification number (see 5.5.6.1)
4	4	S32	Pixels	Location of the centre of the track, relative to the left edge of the image, positive is right
8	4	S32	Pixels	Location of the centre of the track, relative to the top edge of the image, positive is down
12	4	U32	Pixels	Horizontal extent of the track
16	4	U32	Pixels	Vertical extent of the track
20	1	BYTE	-	Track Status 1 – Recent sighting (tracking) 2 – No recent sighting (coasting)
21	1	BYTE	-	Target Confidence (0 to 0xFF) 0 – Very inconsistent target, low confidence 0xFF – Very consistent target, high confidence
22	4	FIXED	Seconds	Time since the first sighting of the target
26	2	U16	-	Position in the priority order list, with 0 being the highest priority target

5.5.6.3. Format 0x1F - Boresight Relative Coordinates

Offset	Length (Bytes)	Format or Value	Units	Description
0	4	U32	-	Track identification number (see 5.5.6.1)
4	4	S32	Pixels	Location of the centre of the track, relative to the image boresight, positive is right
8	4	S32	Pixels	Location of the centre of the track, relative to the image boresight, positive is up
12	4	U32	Pixels	Horizontal extent of the track
16	4	U32	Pixels	Vertical extent of the track
20	1	BYTE	-	Track Status 1 – Recent sighting (tracking) 2 – No recent sighting (coasting)
21	1	BYTE	-	Target Confidence (0 to 0xFF) 0 – Very inconsistent target, low confidence 0xFF – Very consistent target, high confidence
22	4	FIXED	Seconds	Time since the first sighting of the target
26	2	U16	-	Position in the priority order list, with 0 being the highest priority target

[10] Tag Number bit 7 will be set if the tag is the current closed loop tag.
[11] The valid range of the track number is 1 to 255.

5.5.6.4. Format 0x20 - Classifier Augmented Target Data

This target data format outputs target position and sizes with classification and classification confidence when matched with a classifier prediction.

Offset	Length (Bytes)	Format or Value	Units	Description
0	4	U32	-	Track identification number (1 to 255)
4	4	S32	Pixels	Location of the centre of the track, relative to the left edge of the image, positive is right
8	4	S32	Pixels	Location of the centre of the track, relative to the top edge of the image, positive is down
12	4	U32	Pixels	Horizontal extent of the track
16	4	U32	Pixels	Vertical extent of the track
20	2	U16	-	Class - defined on a customer by customer basis. For example: 0xFFFF – No classification 0x01 – Drone 0x02 – Bird 0x03 – Aircraft
22	1	BYTE	-	Classification Confidence: 0x00 – Low confidence 0xFF – High confidence
23	1	BYTE	-	Track Status 1 – Recent sighting (tracking) 2 – No recent sighting (coasting)
24	1	BYTE	-	Track Confidence: 0x00 – Low confidence 0xFF – High confidence
25	4	FIXED	Seconds	Time since the first sighting of the target
29	2	U16	-	Position in the priority order list, with 0 being the highest priority target

5.5.6.5. Target Data Format 0x00 – Single Class Predictions

This target data format outputs single class predictions from the Classifier process.

Offset	Length (Bytes)	Format or Value	Units	Description
0	4	U32	-	Identification number of the Classifier prediction (1 to 255)
4	4	S32	Pixels	Location of the centre of the prediction, relative to the left edge of the image, positive is right
8	4	S32	Pixels	Location of the centre of the prediction, relative to the top edge of the image, positive is down
12	4	U32	Pixels	Horizontal extent of the prediction
16	4	U32	Pixels	Vertical extent of the prediction
20	2	U16	-	Class - defined on a customer by customer basis. For example: 0x01 - Drone
22	1	BYTE	-	Classification Confidence: 0x00 – Low confidence 0xFF – High confidence