ARS

Operator Manual

Rev 2.6

SHOT OVER

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Document Revision History			
Rev Number	Description	Page/ Section	Date
2.18	Original document release	--	--
2.19	Document revision notations added (see note below) Profiles section added Search radius limitation section added Email functionality section added Pilot Display functionality section added Distance measurement functionality detail expanded Misc. functionality enhancements and detail added	--	JUN 2016
2.20	Functionality added, formatting changes applied.	--	JAN 2017
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2.3	Comprehensive document update	--	JUN 2020
2.4	Misc. additions, updates.	--	JUL 2020
2.5	Updates for speed measurement functionality & other updates	--	SEP 2020
2.6	Misc. additions, updates.	--	SEPT 2021

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About this Manual

This manual describes the functionality, procedures, and operating tips of SHOTOVER Systems' Augmented Reality Mapping System. We make every effort to ensure the integrity and accuracy of this manual.

The following symbols for warnings, cautions, notes, and tips are used to throughout this manual.

Warning — Denotes an item where not following an approved procedure creates potential hazards capable of producing injury to personnel or destruction of equipment.

Caution — Denotes an item where not following an approved procedure creates potential mission-capability degradation or mission-equipment damage.

Note — Denotes important information for ARS operators. While not directly related to safety or potential equipment damage, the note symbol highlights important information to consider when operating the system.

Tip — Denotes ARS system usage tips, best-practices, or system operating shortcuts.

Product Guarantee & Warranty Information

For details about SHOTOVER Systems' product guarantee and warranty, please see the Terms and Conditions page available at shotover.com/agreement

To Our Valued Customers:

ARS (**A**ugmented **R**eality Mapping **S**ystem) is an advanced mission management and mapping system designed to augment full-motion video in real-time with geospatial information. While supporting extremely advanced mapping capabilities, ARS is also straightforward to use, emphasizing *getting out of the way* and *figuring out what the operator wants*.

We believe simple things should be simple, and complicated things should be possible. As you learn the concepts behind ARS, we believe you will grow to appreciate the philosophy behind the design and become a proficient operator with a dramatically increased ability to perform your mission.

We designed ARS not only to increase the speed and accuracy that sensor operators can determine target locations but also to solve a longstanding problem: how to identify where the target is without taking your eyes off the action.

We encourage feedback and look forward to suggestions on how we can continue improving ARS. You are the reason we do this – please let us know how we can best serve you.

Sincerely,

Tom Churchill
CEO, SHOTOVER Systems

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Overview

SHOTOVER Systems' **A**ugmented **R**eality Mapping **S**ystem (ARS) is an advanced airborne mission management system offering radical improvements in situational awareness. ARS composites street information, parcel information, business names, and other custom data directly over EO/IR video in real-time. ARS also displays mapping information incorporating three-dimensional, high-resolution aerial and satellite imagery. Overlaying data can be easily configured with the press of a button, allowing operators to stay focused the target.

ARS Video Mode with Street and Address Overlay

ARS's use of perspective and awareness-enhancing synthetic imagery allows the airborne operator to plan the mission long before reaching the target location. These features dramatically improve situational awareness during non-optimal sensor views such as long distances, poor weather conditions, and darkness.

Pressing a single button slews the gimbal and locks it to a location. Locations can be entered quickly via the search dialog box by entering an address, business name, coordinates, marker name, or other locational data.
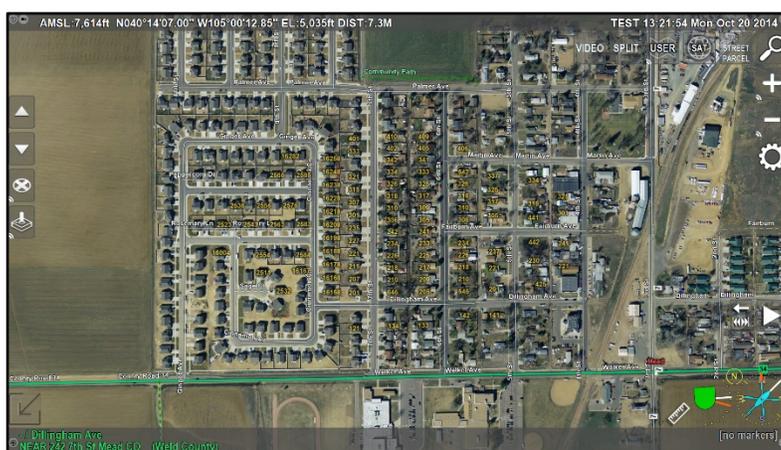
ARS top-down Map Mode with Synthetic Imagery

ARS also includes features such as speed and direction of travel, the ability to upload and save marker locations, automatic camera steering, and the option to incorporate customized imagery and overlay data.

ARS integrates recording of HD or SD video to removable media sources. Video is recorded in MP4 (H.264) and includes simultaneous playback and recording. STANAG 4609 Compliant KLV metadata is also recorded and can be downlinked or used in ground applications for analysis and review.

With interfaces and control for an ever-growing list of external systems, ARS is a robust **Mission Management System**.

The ARS functionality described in this manual uses the following convention: On-screen buttons and menu items are **bold-faced** and, when applicable, followed by their corresponding keyboard shortcut in parentheses. For example, to activate Video Mode press the **VIDEO** button (**F1**). Menu Paths, Options, Settings, and Modes are *Italicized.* Additional noteworthy items are *italicized and underlined*.

User Interface

There are two primary ways of interacting with ARS:

1) Touchscreen Display
2) Physical Keyboard

Nearly all task completion is input device independent. However, each input device has unique features, lending itself to supporting some features on one that may not be supported on the other.

In some cases, touchscreen-equipped installations may not have a physical keyboard but can utilize the on-screen touch keyboard.

For example, you can place a marker anywhere on the screen by simply touching the monitor on touchscreen-equipped versions of ARS.

When using a keyboard, the place marker key command (**X**) places a marker at the center of the screen.

Custom user input devices are available to suit your mission requirements. Contact SHOTOVER Systems for more information.

Basic Functionality

ARS is designed with three primary display modes: *Video Mode*, *Map Mode*, and *Split Mode*. Within each mode, the operator can toggle various pieces of on-screen information and configure views best suited for their mission and preferences. The three main display modes are shown and described in detail below.

VIDEO MODE

VIDEO

Or

F1

Pressing the on-screen **VIDEO** button (**F1**) enters Video Mode displaying real-time video with ARS's configurable overlay data.

MAP MODE

Or

F2

F3

F4
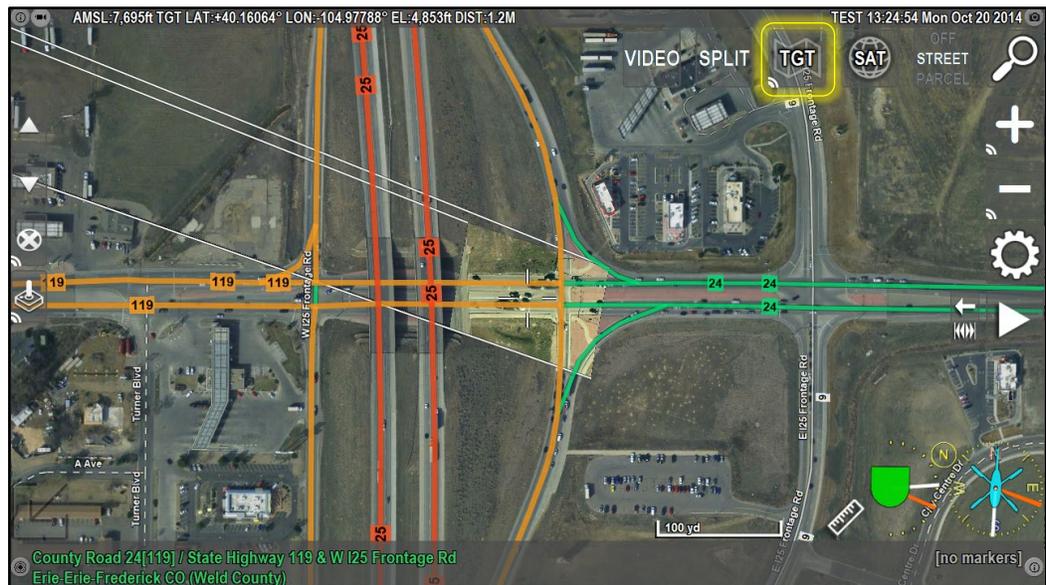
Map Mode offers three centering methods of the map mode view and a user-controlled mode. **F2** centers on the camera target, **F3** on the active marker, and **F4** on the aircraft. Pressing the on-screen **MAP** button displays a drop-down menu of each mode as well.

SPLIT

MODE

[SPLIT]

Or

[F5]

Split-Mode using a Side by Side configuration

Pressing the on-screen **SPLIT** button (**F5**) enters Split Mode allowing operators to view both the live video and map layers simultaneously.
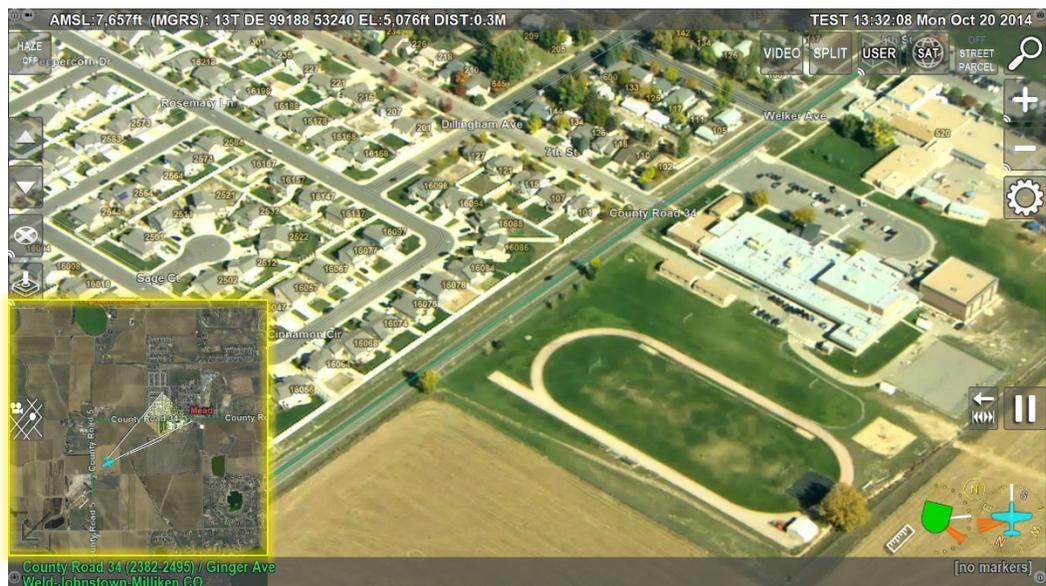
Split Mode using a Map Inset configuration

Operators can configure Split Mode to be a Map or Video Inset rather than a vertical line split via: *Menu/User Preferences/Video Options/Split Mode/Map (or Video) Inset.*

TIP

Split Mode is especially helpful for gathering information about the surrounding terrain without losing sight of the target. For example, viewing upcoming streets and intersections during a pursuit.

View Controls

Moving around and zooming in and out of the view on various ARS modes can be easily accomplished via the touchscreen, keyboard, or a pointing device (mouse, trackball, etc.).

PAN / MOVE   Panning or moving around the map is accomplished by swiping your fingers across the touchscreen in any direction, using the **Arrow** keys on the keyboard, or clicking and dragging using a pointing device.
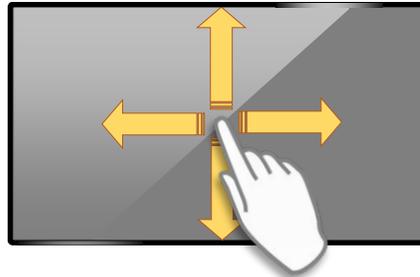
Touchscreen-based pan/move controls   *Keyboard-based pan/move controls*
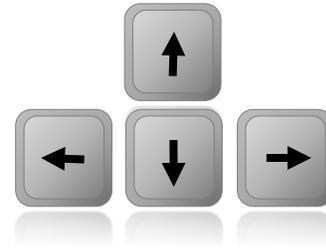
ZOOM IN /   Zoom any view in or out via the on-screen **plus** and **minus** buttons (**+/-**) typically
ZOOM OUT   located on the right side of the ARS screen. Multi-touch capable touchscreens feature a pinch-to-zoom gesture configurable by SHOTOVER Systems Support.

On keyboard, zooming is also accomplished by pressing the **page-up** and **down**, **square bracket**, or *non-numpad* **plus** and **minus** keys.
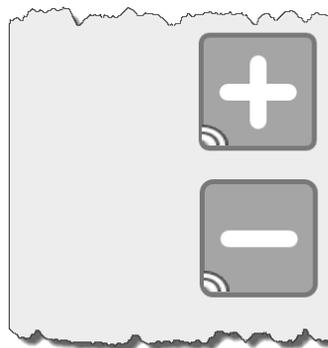
On-screen zoom controls   *Keyboard-based zoom controls*
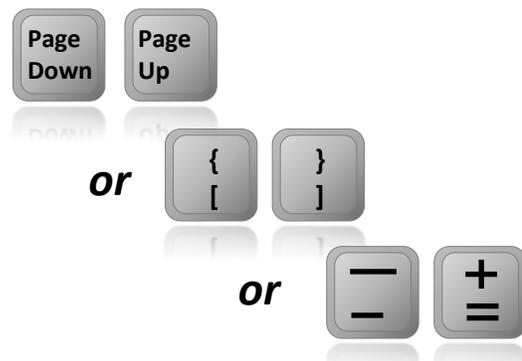
Pressing two keyboard-based zoom keys simultaneously zooms at a faster rate than a single key. For example, press and hold the **page-down** *and* **minus** keys to quickly zoom out.

TIP   Using a *long press* (press and hold for 1 second) on the on-screen plus or the minus buttons resets the zoom to the default zoom level.

On-screen Buttons

ARS emphasizes operator-centered design. Easy to use on-screen buttons control many of the system's features and are activated using a touch screen monitor or pointing device cursor.

Keyboard shortcuts are also available and denoted by bold parentheticals (**Shortcut Example**).

On-screen buttons vary based on your system's included interfaces. The _standard_ on-screen layout and functionality follows:

HAZE DAY adds filtering to the video image set for daytime use.
HAZE NIGHT adds filtering to the video image set for night use.
HAZE OFF turns all haze filtering of the video image off.

Note: Haze filtering is performed within the ARS video only and does not alter the raw video output from the camera.

Up-Arrow selects the next marker.

Down-Arrow selects the previous marker.

Delete Marker deletes the active marker, long-pressing deletes _all_ temporary markers. If a marker is _not temporary_, a secondary, red delete button appears for confirmation. Pressing the red button removes the active non-temporary marker. See page 22 for more information about markers.

Joystick slews the camera to the active marker. Long-press to lock onto moving markers such as AIS, CAD, and AVL/BFT.

Declutter Arrow declutters the screen hiding non-critical on-screen buttons.

VIDEO toggles between Video and Synthetic Imagery mode.
- *VIDEO* displays the live video on-screen.
- *VIDEO SYN* displays a synthetic view (aerial imagery) of the area based on the camera view.

SPLIT enables a split screen display with the live video displayed on the one half of the screen and the selected map type displayed on the other half of the screen.

MAP allows the operator to change the center point used by the system while operating in top-down map mode. Long-pressing **MAP** enables auto-zoom.

MAP incorporates several top-down map center options:
- *ACFT* centers the map on the current aircraft location.
- *TGT* centers the map on the camera target.
- *MRKR* centers the map on the active marker (requires an active marker).
- *USER* indicates the map has been centered in a location chosen by the operator.

> **Note:** Long-pressing **MAP** enables autozoom. This feature sets the ARS zoom level to allow the operator to keep both the marker and the aircraft, or the marker and the target in view while operating in map mode.

Imagery selects different imagery (base map) types loaded in ARS. The button name changes based on your selection as shown below. Select the imagery button to select the top-down map imagery type:
- *SAT* displays satellite imagery.
- *TOPO* displays a topographic map.
- *AIR* displays aeronautical sectional charts (where available)
- *NAV* displays a vector-based street map.
- *NIGHT* displays a night-optimized street map.

> **Note**: The map data installed in ARS can vary based on area and availability. Other types of imagery, such as nautical charts and trail maps, can be configured based on operator needs. Contact SHOTOVER Systems for additional information.

Overlay (O) toggles on-screen overlay information on or off.

- *OFF* shows *clean* video only without overlay detail.
- *STREET* displays the street lines and street labels on-screen.
- *PARCEL* displays the rooftop address numbers on-screen and parcel outlines (if available).

FIND opens the search feature within ARS to find a location. Full functionality is detailed later in this manual.

Zoom In, long-press to reset to default zoom level.

Zoom Out, long-press to reset to default zoom level.

MENU opens the on-screen menu. Full functionality is detailed later in this manual.

REC starts recording connected video and audio. This button turns yellow (**Wait**), then red, indicating a live recording. A yellow **Wait** state means ARS is dumping its 15-second recording buffer before writing data to removable media when starting a recording, or ARS is finishing writing data to the removable media once recording has ended.

> **Note:** A yellow **Wait** state may also indicate missing removable media, or the removable media is nearing its full storage capacity.

> **Note:** Secondary buttons such as **REC SCR** or **REC CAM** are configurable to record the ARS screen, including overlays or "raw" video, depending on setup.

Playback Controls

ARS features *DVR-like* playback controls that are used in conjunction with live video or playing back previously recorded video. See the *Video Playback Controls* section under *Recording & Playing Back Video* in this manual for full explanations of functionality and keyboard hotkey combinations.

Playback Position Indicator & speed

1.00x

Active Marker Key Frame — Other Marker Key Frames — Rewind To marker — Fast Forward To marker — Speed up / slow down playback — Return to Live View — Hide Playback Controls — Play / Pause Button
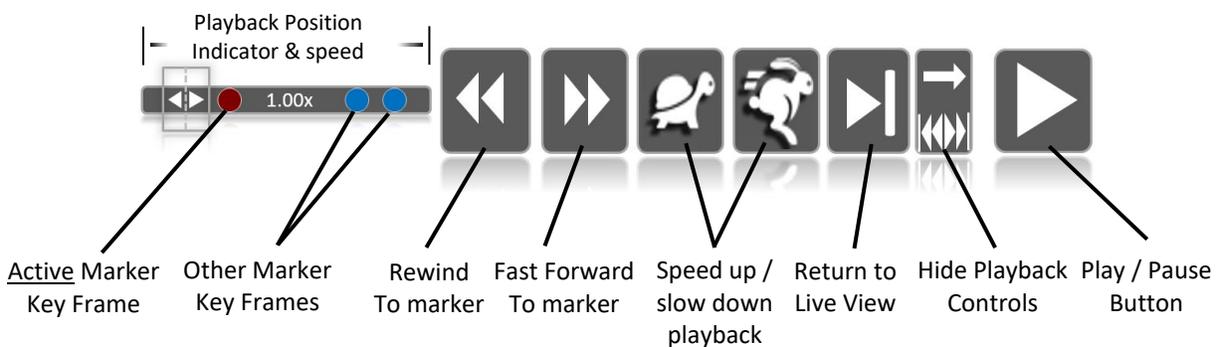
Shortcut Bar

The shortcut bar is an optional function that can be added to the ARS interface giving operators quick access to frequently used tasks and features. This feature is highly configurable and can be used to give the operator _one-click_ access to commonly used menu options, functions, and tasks. Because of its highly configurable nature, please contact SHOTOVER Systems for additional details or setup.

The customizable Shortcut Bar can provide quick, one-button access to frequently used ARS features.

Video Mode

ARS displays real-time video in video mode. Additionally, ARS displays geospatial information such as street lines, street names, rooftop addresses, parcel outlines, and business names on top of live video. As a result, the operator can instantaneously orient and provide information about the target location.

Video Mode with street and parcel outline overlays.

Video Mode Functionality

VIDEO (**F1**) enters live video mode.

Overlay (**O**) toggles on-screen overlay information on or off.

- *OFF* shows video without overlay detail.
- *STREET* displays the street lines and street labels on-screen.
- *PARCEL* displays the rooftop address numbers on-screen and parcel outlines (if available).

The **F** key on the keyboard fades between the live video image and the synthetic imagery layer.

On-screen **plus** and **minus** buttons, **page-up** and **page-down** keys, left and right **square-bracket** keys, *and* non-numpad **plus** and **minus** keys all zoom in and out.

Zooming outside the camera's field of view displays the synthetic imagery layer behind the video giving the operator an expansive, synthetic field of view.

Map Mode

Map Mode provides a top-down view of the world within ARS. The system can load several types of maps including street maps, air navigational charts, nautical charts, and satellite/aerial imagery. The maps loaded onto your system greatly depend on the geographical area, operator requirements, and availability of mapping data.
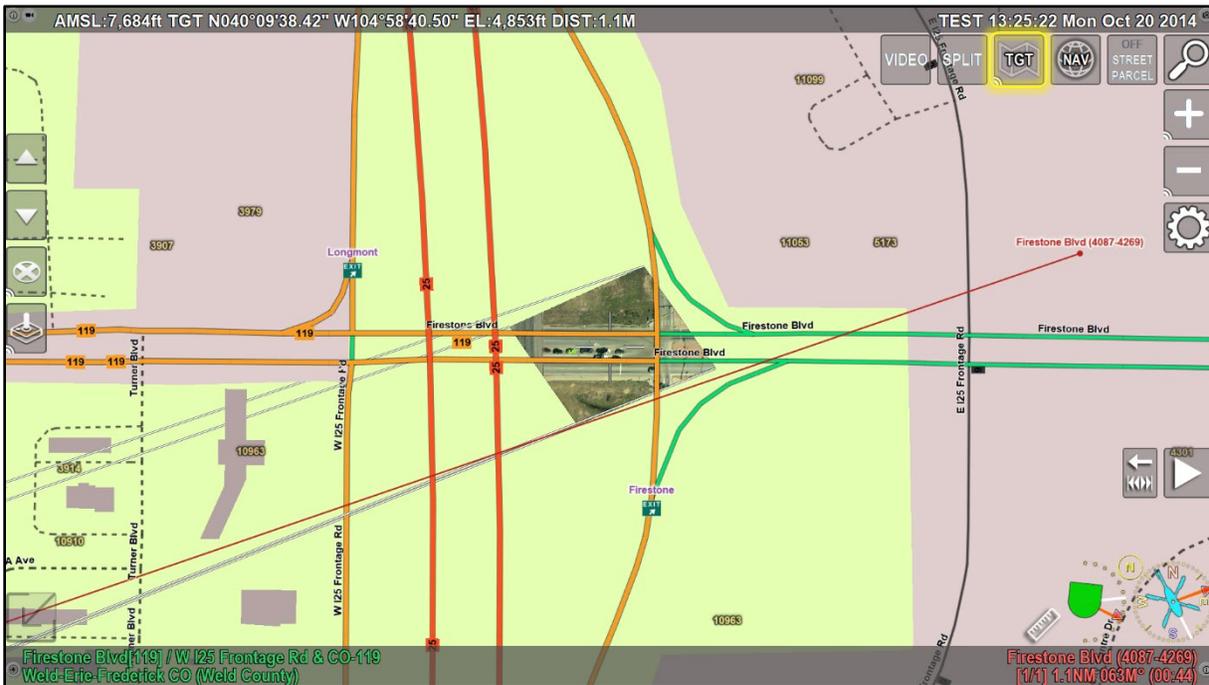
Top-down map mode view centered on the camera target (street map display and camera projection frustum enabled)

Within Map Mode, the operator can freely pan and zoom around the map or center the map at various pre-defined points. These points are: *1)* centered on the aircraft, *2)* the active marker or *3)* the camera target. Pressing **MAP** displays a drop-down list for selecting these center-points.

Map Mode Functionality

 MAP ACFT (**F4**) centers the map mode view on the aircraft's position.

 MAP MRKR (**F3**) centers the map on the active marker.

 Note: If no markers are present, *MAP MRKR* mode is unavailable.

MAP TGT (**F2**) centers the map on the target (where the camera is currently pointing).

MAP USER indicates a map center change to something other than the aircraft, marker, or target. This mode is not selectable as a preset map center location button.

> **TIP** Long-pressing the **MAP** button enables auto-zoom. This feature automatically sets the ARS zoom level allowing operators to either keep the aircraft and marker, or the aircraft and target in constant view on the map-mode display.

Imagery (**I**) allows the operator to change the base map imagery quickly and easily. Pressing this button expands a drop-down list where desired imagery layers are selectable. Imagery layers vary by installation, but typical installations include satellite/aerial imagery, topographic, aviation sectional, and street navigation-style maps.

Overlay (**O**) toggles on-screen overlay information on or off.

- *OFF* shows *clean* video only without overlay detail.
- *STREET* displays the street lines and street labels on-screen.
- *PARCEL* displays the rooftop address numbers on-screen and parcel outlines (if available).

Split-Screen Mode

ARS can display output from both Video and Map modes simultaneously in a split-screen format. This feature is handy for increasing situational awareness or quickly developing a _big picture_ view of the terrain, all while keeping eyes on target.

Split-screen Mode showing live video (left) and satellite imagery top-down map (right)

Split-Screen Mode Functionality

SPLIT (**F5**) enters split-screen mode. Pressing the (**I**) key cycles the base map imagery. Configure split screen displays via _Menu/User Preferences/Video Options/Split Mode_. Choices include _Side by Side_, _Video Inset_, and _Map Inset_ (pictured on page 9).

Split-Screen enables an on-screen dedicated overlay button (**ALT+O**).
This button toggles overlays on or off _for only the video side of split-screen_.

TIP Tailor screen layouts to individual preference via _Menu/User Preferences/Video Options_. For example, one can choose to show video on the left or right side or set the video to show centered (pictured above) or zoomed-in to fill the assigned pane.

To exit Split-Screen mode, press **SPLIT** (**F5**) a second time. Exiting Split-Screen Mode returns to the previous mode before Split-Screen was activated.

Note: If originally in Video Mode and the map has changed in any way during the Split-Screen operation, such as changing the map mode or panning the map, the system returns to Map Mode. If the map is unchanged, it returns to Video Mode. If the system was in Map Mode before Split-Screen Mode was activated, it returns to Map Mode.

Map Orientation & Gimbal Azimuth

In all modes, the lower right corner of the ARS screen displays gimbal azimuth and FOV using an orange triangle originating from the aircraft icon. As the operator zooms out, the triangle will get wider. Conversely, as the operator zooms in, the triangle will get narrower.

This area also doubles as a **Compass Indicator** (**F6**) that can be used to change the map orientation. The small yellow circle to the upper-left of the on-screen compass displays an icon denoting the selected orientation: *North-Up*, *Track-Up*, or *Camera Target-Up*.

The symbology for map orientations within ARS is as follows:
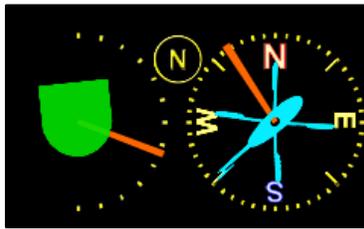
North-Up orientation
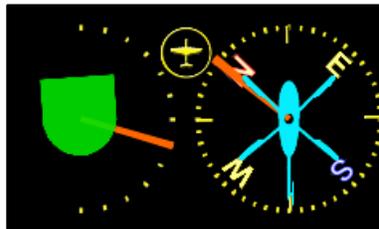
Track-Up orientation
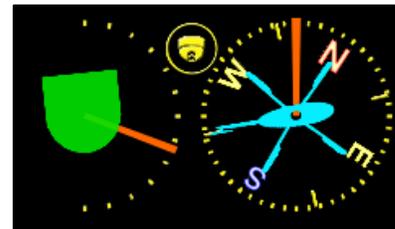
Camera Target-Up orientation

> **Note:** The camera's field of view and target determines the map center and orientation. As a result, map orientation and center are *not changeable* in video and user map modes.

Gimbal Elevation & Status Icon

The lower right corner of the ARS screen displays gimbal elevation and FOV using an orange triangle. Operating status is represented by gimbal-icon color.

The colors report on the availability of features such as the camera area viewed. ARS determines this status and does *not* represent gimbal diagnostics. The colors and meanings are detailed below:
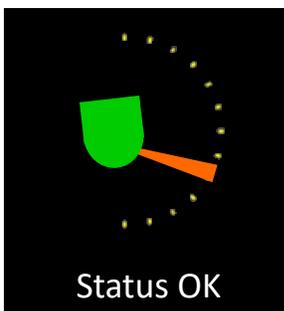
Status OK

Green – Fully Operational

Caution Range

Yellow – Minimum feature size* is unidentifiable. Too zoomed out to record all 4 corners within the frame based on set feature size.

* Used mainly for SAR patterns.

Warning Range

Red – Too close to, or above the horizon. Also approaching gimbal lock or nadir.

On-screen Information

Each corner area of the ARS on-screen display is configurable to show advisory information and perform or indicate actions. Three of the four corners display both primary and alternate textual information. Touching the area over the text or pressing designated hotkeys cycles between the primary and alternate information displays.
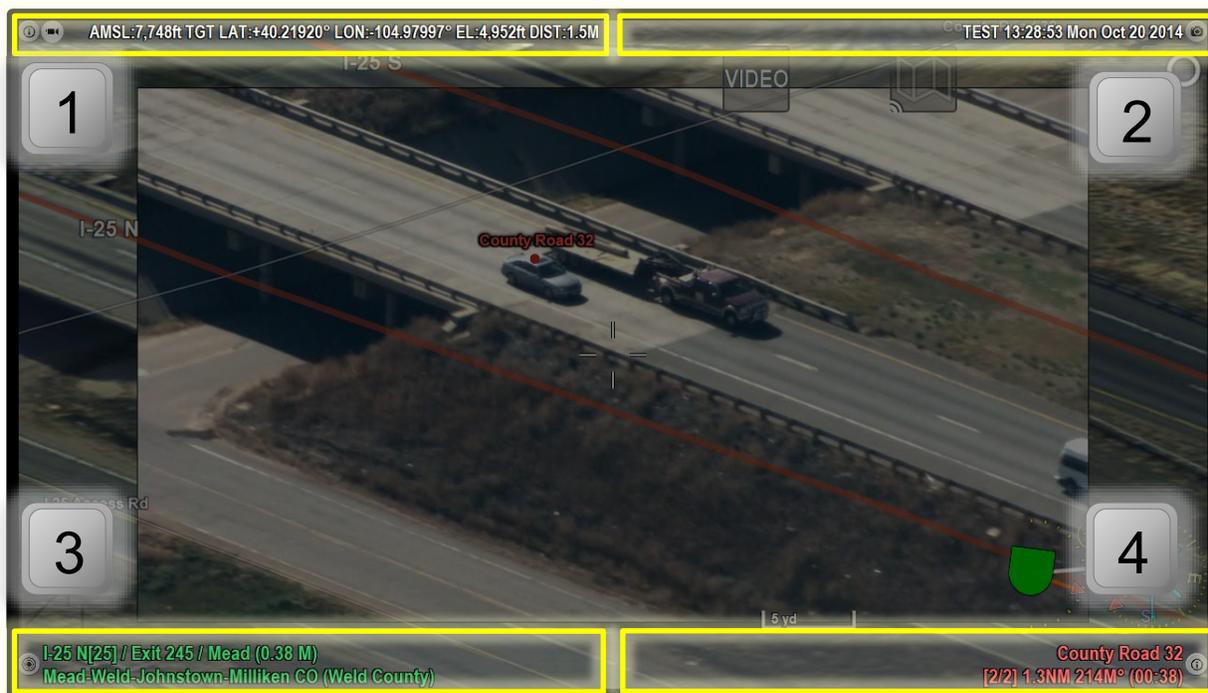
Upper Left of Screen	
1 **Hotkey = 1**	![ALT display] ALT:7748ft TGT LAT: +40.21920° LON: -104.97997° EL:4,952ft DIST:1.5M **Primary Display**: Aircraft altitude; Aircraft (ACFT), Target (TGT), or Marker (MKR) latitude and longitude, elevation, and distance. ![Playing display] Playing (00:03:44/00:19:44) (ARS-FILENAME.TS) **Alternate Display**: Recording status, elapsed time, clip length, file name, and recording device used.

Upper Right of Screen	
2 **Hotkey = 2**	![DEMO display] DEMO (profile) 13:28:52 Mon Oct 20 2014 **Primary Display**: Agency name, profile (if one is active), local time (UTC + time offset), and date. **Primary Function**: Take a screenshot. Press the corner or use the **2** key on the keyboard. Screenshots are saved to removable media on the specified drive. The system is configurable to auto-place markers when taking screenshots allowing the operator to review screenshots for markers mid-flight. A screenshot icon

appears in the info-box when the additional marker information is activated (**A** key or pulsing red icon).

Clicking on this icon (**ALT + A**) opens the screenshot review dialog. Once activated, you can then cycle through other screenshot markers, zoom in and out, and move or center the image.

Example of this feature's utility is quickly capturing the number of suspects fleeing a vehicle or a license plate number. By taking a screenshot, the operator can later return to the moment in time when the screenshot was captured to obtain additional information or review the event.

Lower Left of Screen **3** **Hotkey = 3**	**123 OAK STREET, Mead CO (Weld County)** **Owner: SMITH GEORGE A** **Primary Display**: Closest street and intersection (address also displays if available). Centering the camera over a dense area of interest such as a county, school, or park is also indicated. ✔ **Note**: Custom information such as radio frequencies or precincts is also loadable in this location. Contact SHOTOVER Systems for more information. **Alternate Display**: Clicking the lower-left corner displays the address and property-owner information. ✔ **Note**: This click-spot is configurable and may instead toggle the north indicator.
Lower Right of Screen **4** **Hotkey = 4**	**County Road 32** **[2/2] 1.3NM 214°M (00:38)** **Primary Display**: Marker location, sequence, distance, heading, and ETE to marker. **Weld County** **LAT: +40.21911° LON: -104.97991° EL:4952ft (00:35 ago)** **Alternate Display**: Marker notes, latitude, longitude, elevation, and time elapsed. 💡 **TIP** If a marker contains additional information, such as clicking on an airport, antenna, or other POI, the indicator in the lower right pulses red. Pressing the indicator or the **A** key shows additional marker information.

The upper right-hand corner has both a primary display and a primary *function*. This function takes a screenshot, which is triggered by touching the upper right corner or by using the keyboard hotkey.

Lines on the Map:

The **red** line connects the aircraft to the currently selected marker.

The **aqua** line connects the aircraft to the nearest street, then the nearest intersection.

The **green** line connects the aircraft to the target (where the camera is pointing)

When panning around the map, a **cyan** line (not shown above) connects the center of the map to the aircraft helping to locate the aircraft on the map.

There are additional optional lines for heading (shown in **blue** above), north indication, and camera direction. Map lines are configurable in *Menu/User Preferences/Map Options*.

Markers

Markers designate, save, and label locations. Markers allow the operator to enter a destination, steer to a point for the camera, set a reminder of a specific area of interest, or mark evidence to later revisit.

Marking areas of interest in video mode

General Information

Markers represent a specific point (usually on the ground) and are created by searching or by manually marking locations using the touchscreen or keyboard shortcut in any ARS mode.

Placing a marker captures information such as the address, coordinates, ground elevation, and name. There is an unlimited number of markers; however, only one marker at a time is the _active marker_. On-screen, the active marker is red, and all other markers are blue.

> ⚠️ **Unless saved**, all markers will be deleted when the system is powered off.

Placing a Marker:

There are four methods for placing a marker in ARS:

- _Search_: press the **FIND** button (🔎) to search for the marker location.
- _Keyboard_: press the **X** key to place a marker at the center of the screen.
- _Touchscreen_: touch anywhere on the screen to place the marker.
- _Mouse or Trackpad_: click anywhere on the screen to place the marker.

Saving Markers:

Use the **MENU** button (**M**) to bring up the main menu. Save markers created during a session by selecting _Save Markers_. Markers are saved to the removable media as either a Keyhole Markup Language (*.KML) file, Shape File (*.SHP), or GPS Exchange File (*.GPX).

Main Menu	
Point Layers >	
Line Layers >	
Shape Layers >	
Dynamic Layers >	
Load Recording >	
Toggle North Indicator	Off
Measurement	Disabled
Toggle Waypoint Display	Off
Load Markers >	
Save Markers	
Save Session	
Keyboard Help >	
User Preferences >	
System Check >	
Initial Setup >	
Quit ARS	
Restart ARS	
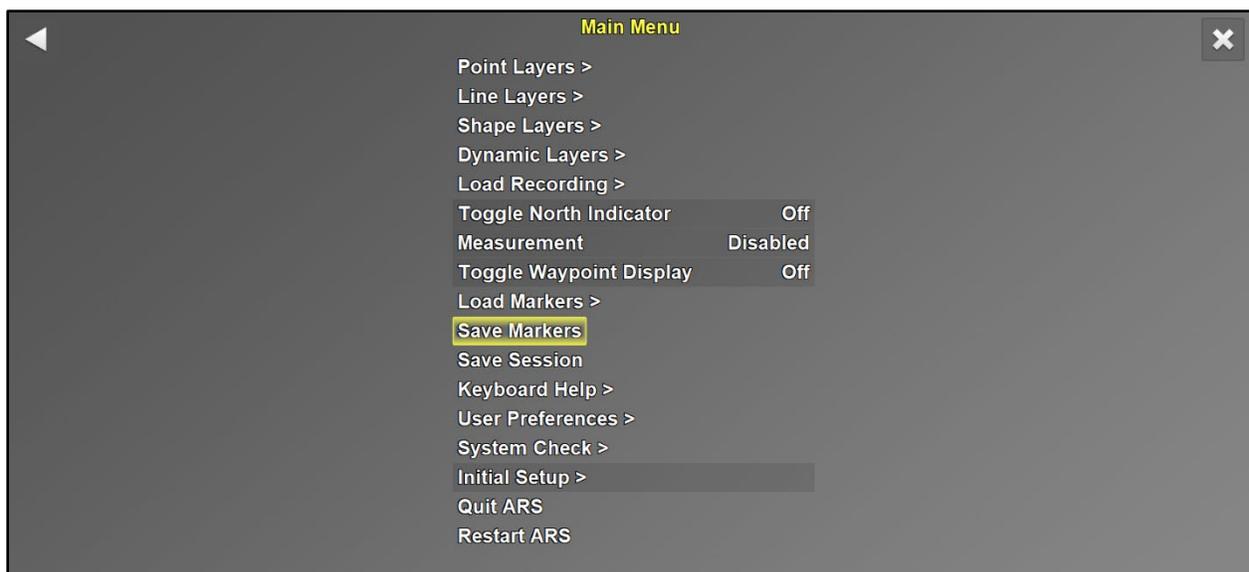
Saving markers via the ARS menu

> ✔️ **Note:** Markers are saved as KML files by default. To change the default file format, navigate to _Menu/User Preferences/Marker Options_. Clicking _File Format_ expands a dropdown menu where the default file format is selected.

Loading Markers

Bring up the menu with the **Menu** button (**M**) and navigate to *Load Markers* to load previously saved markers. ARS presents a list of previously saved selectable markers. Use the keyboard to select the desired marker(s) and press **Enter** to load.

Editing a Marker Name

By default, markers are named after their address or location. To replace the default name with a more descriptive name, press and hold the lower right corner or use the **ALT+X** keyboard shortcut. Press **Enter** to save your entry and associate it with a marker.

New names are shown in the lower right corner of ARS.

Renaming the active marker makes quick identification easier

| | | This feature is useful for quickly identifying and differentiating between several placed markers. In these cases, providing a descriptive name makes searching for a specific marker much easier. |

TIP — This feature is useful for quickly identifying and differentiating between several placed markers. In these cases, providing a descriptive name makes searching for a specific marker much easier.

Marker Controls

Single or Long-Press	**D**	Delete the current, active marker.
	ALT+D	Delete *all* markers. ** In cases where a marker's type has been changed, a secondary (red) delete button appears.*
	P / N	**P** (**P**revious) and **N** (**N**ext), used to cycle between markers.
	G	Slews camera and locks to the active marker (single press).
	ALT+G	Locks onto moving markers such as AIS, CAD, and AVL/BFT. Touchscreen users *long press the on-screen button* to activate.
Press & hold lower right corner	**ALT+X**	Rename the active marker.
	A	Show additional marker information.
	CTRL+Z	Undo deletion of the most recent marker. The on-screen button remains visible for five seconds. However, **CTRL+Z** is available until the next marker is deleted.

Marker Notes

- List all markers using the **Find** button (**Spacebar**) and choose the markers tab. Use the touchscreen and **Arrow** keys to cycle between tabs and choose selections within the tabs.

- Markers are _temporary_ and _deleted_ when the system is powered off**.**

- Use the _Menu/Save Markers_ to save markers from your session. Markers are reloaded using _Menu/Load Markers_.

- Save markers as a .KML file (default) by going into the menu and choosing _Save Markers_. Additional options for saving in .SHP or .GPX file formats are available in _User Preferences_.

- Saved markers are reloadable into ARS, Google Earth, or other GIS programs like ESRI, etc.

- Slewing the camera to a marker behaves differently depending on the gimbal: On FLIR Star Safire cameras and Wescam MX systems, the camera immediately points to the active marker and the system enters a geo-point mode where control authority immediately returns to the user.

- Camera systems such as the FLIR U-8XXX series causes ARS to enter GEOHOLD mode (indicated by text on the top of the screen). The operator must exit GEOHOLD mode to return control authority to the FLIR hand controller. Note, the ARS **Joystick** button changes to a magnifying glass indicating GEOHOLD mode is active for the FLIR 8500.

- Note that the FLIR U-8XXX can only be placed in GEOHOLD mode when the camera is in POS mode (Shift-POS on the hand controller is needed for some installations). The FLIR Talon will only enter GEOHOLD mode when _External Control_ is enabled via its menu.

Marker Icons

Operators can change marker icons from the rename marker dialog. Changing marker icons allows the marker to be more noticeable or to signify other information such as points of interest or ground unit positions. Default ARS icons are available as well as optional Mil-Standard 2525C (NATO) icons.

When a marker icon has been associated with a marker, the icon will be displayed in the lower right of the ARS user interface. This makes it easier for the operator to quickly reference specific markers without having to open the marker information panel.


Showing Additional Coordinates

Sometimes operators must provide marker coordinates in multiple formats to assist ground units or other agencies. To configure the on-screen display to show the coordinates of markers in all available formats, enable the *Additional Coordinates* feature located in:

*Menu/User Preferences/Marker Options/Additional Coordinates/ON*.

Once enabled, clicking the marker's additional information indicator ⓘ (**A**), in the lower right of the screen displays the coordinate listing.

This feature gives the operator immediate means of converting marker locations into different coordinate systems.
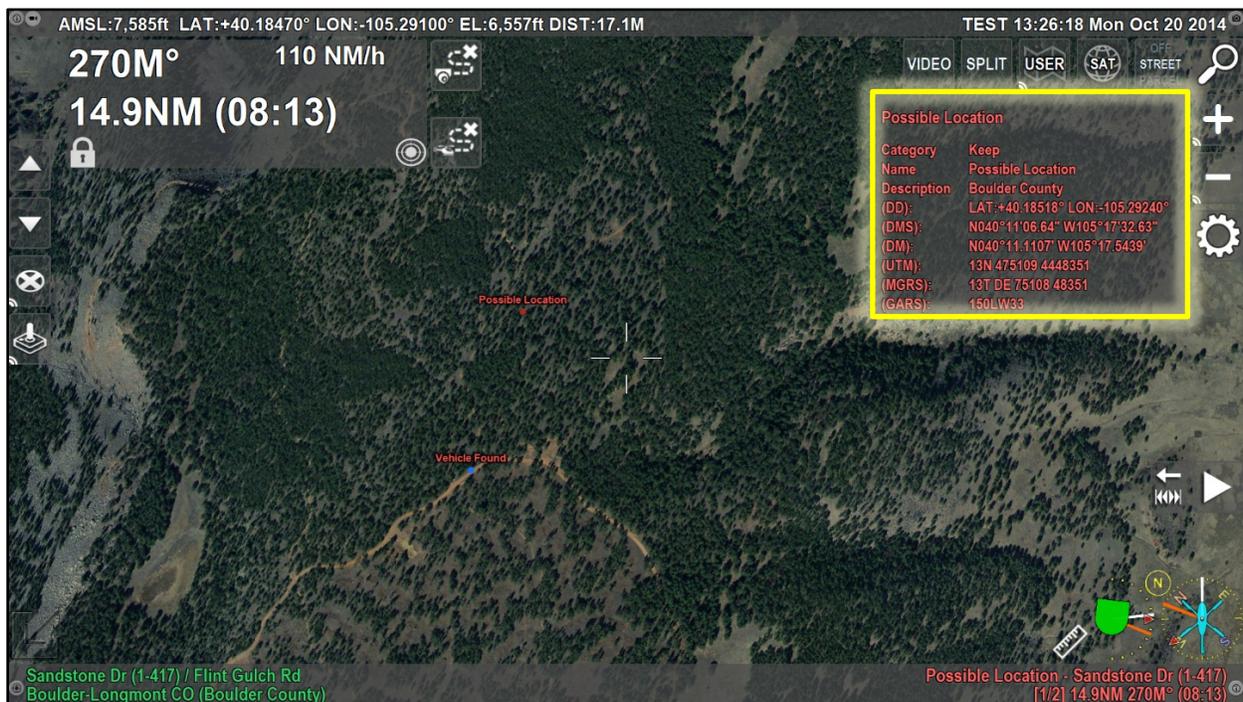
A marker's location shown in all configured coordinate systems.

Search
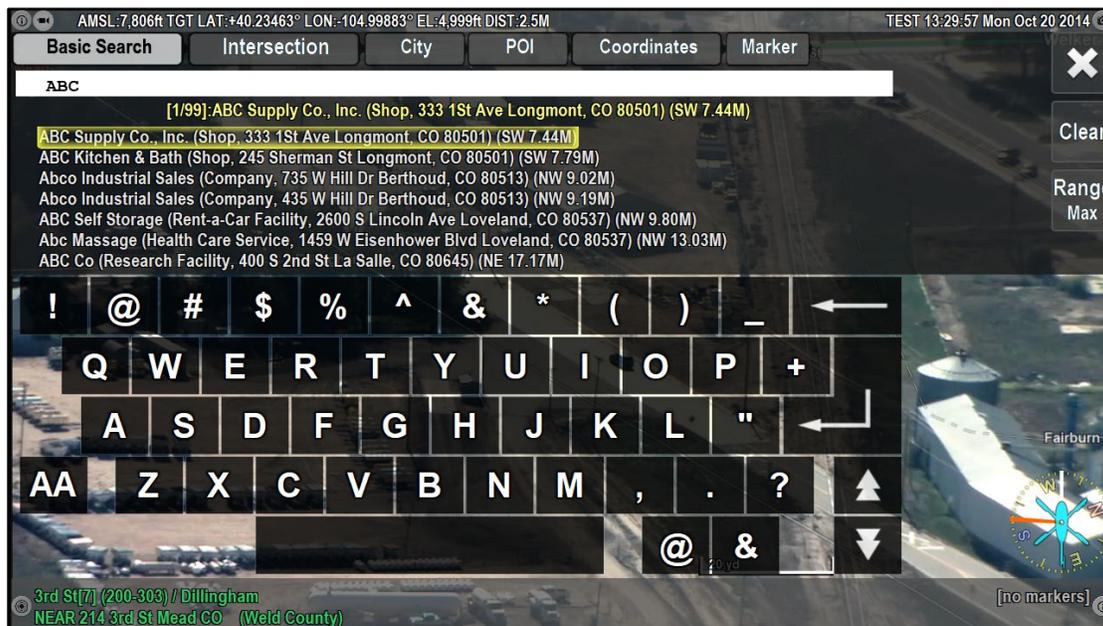
Utilizing the Basic Search tab in ARS

General Information

Google sets the standard for internet search – It is simple, fast, and generally does the right thing. ARS emulates this model by eliminating special codes, requirements for knowing the county of an address, and continuously adding as much searchable content as possible into ARS.

Find/Search (**Spacebar**) displays the search dialog box.

Basic Search

The Basic Search tab provides multiple search options including addresses, business names, markers, and cities. Information is entered and located using only the Basic Search Tab.

Additional tabs provide more focused search options such as intersections, cities, points of interest, coordinates, and markers. Use the **Arrow** keys or touchscreen to select any of these tabs. After entering a location, Search auto-adds the location as a marker and displays the location on-screen.

Searching for a Location/Business/POI/City/Marker

1) On the *Basic Search* tab, type an address, business, POI, City, or marker name.

2) While typing, a suggestion list displays potential matches.

3) Select the desired match and press **Enter** to confirm.

Searching for an Intersection

1) On the *Intersection* tab, enter the first street name in the box.

2) Select the next box via the touchscreen or **Tab** key and enter the cross-street.

3) While typing, a suggestion list displays potential matches.

4) Select the desired match and press **Enter** to confirm.

TIP Entering intersections works best by <u>not</u> entering any cardinal directions. Only street names and numbers are necessary. Generally, the less typing the better.

Searching by Coordinates

1) The *Coordinates* search tab integrates several coordinate systems. Pressing the *Coordinates* search tab via the touchscreen or **Arrow** keys cycles through the different coordinate system options.

2) Enter the coordinates to search in the corresponding format.

3) While typing, the system displays the coordinate data in all supported coordinate system formats. This display format allows the operator to accept a given coordinate format and quickly convert it to a more familiar format.

4) Select the desired coordinate representation and press **Enter** to confirm.

Other Search Types

While the majority of search queries may be within the All or coordinates search tabs, additional options exist to allow further refinement of searches. For example, operators can search by query types designated for City name, Points of Interest (POI), Mileposts (where available), Layers, etc.
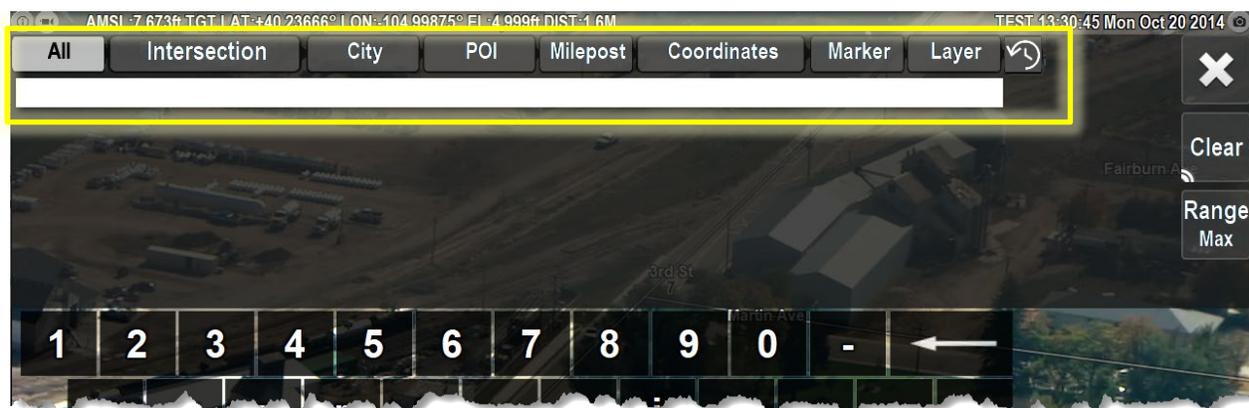

The search history icon ( ) provides access to any previous search queries where a marker for the search results was created (i.e. the operator pressed enter or selected the search result).

Search Notes

- While entering a search location or address, results and potential matches are displayed below the search box, organized by proximity.

- Setting the search center sorts results by distance from the aircraft or camera target. Locate Search Center in *Menu/User Preferences/Search Options/Search Center*.

- When searching for addresses and locations in specific areas not nearby, change the map center (and thus default search area) by going to the *City* tab, entering and selecting the new location, and then conducting your search. Search suggestions are sorted based on the new map center.

- **Up** and **Down Arrow** keys allow scrolling through off-screen results.

- The *Markers* tab lists all current markers available to use as search locations.

- To clear the search entry field, use the **Shift + Backspace** shortcut

- To modify the search query text, press and hold the **Shift + (Left or Right) Arrow** key.

- To exit search, press the **X** icon in the upper right of the screen or use the **Escape** key.

Search Radius Limit

ARS allows operators to limit the search radius of the search results with respect to the map-center. Adjust the search radius limit in *Menu/User Preferences/Search Options/Search Radius*. Search Radius Limit is entered in meters but displayed in preferred units on the right side of the search window.
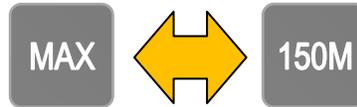

After defining the search radius limit, operators can select the **Range Max** button toggling between a maximum unlimited search radius and an operator-defined, limited search radius.

Note: A system restart is required after changing the Search Radius Limit.

Show All Search Results

Operators can simultaneously display all search results on the map. First, select the *Range Map* option to the right of the search results. Once *Range Map* is displayed, press the physical or on-screen **Enter** key to display all search results on the map.
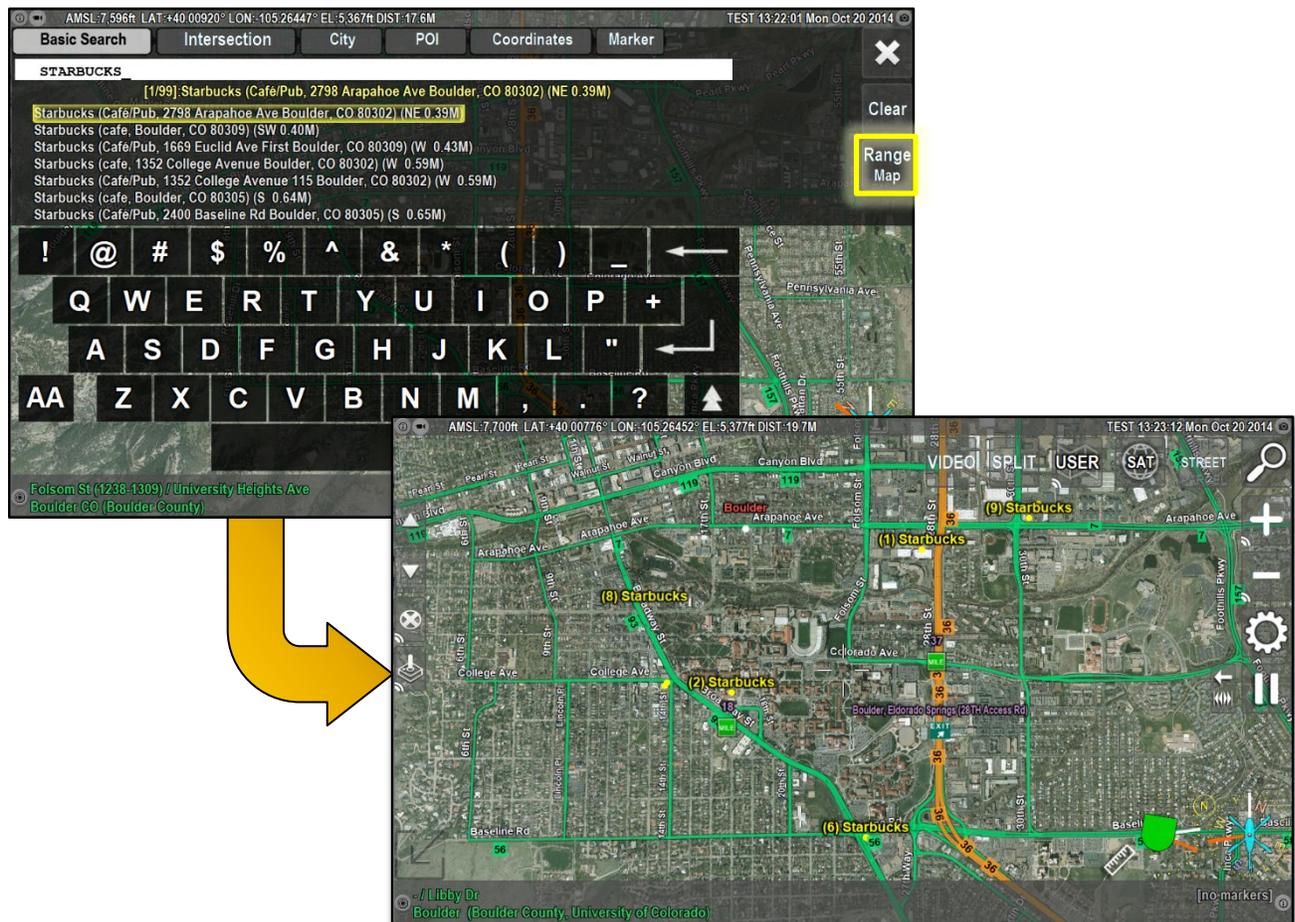
When Range Map is selected, all locations matching the query are displayed on the map.

Recording & Playing Back Video

ARS includes a built-in digital HD/SD recorder that can record two channels of video and metadata to external, removable media sources such as SD cards and USB flash drives.

The unit records video in H.264 format allowing playback on most media devices, including computers, smart TVs, tablets, and other devices. M2TS, TS, and MTS formats are also available.

ARS also provides playback while recording. External, removable media must be connected to enable recording. Without a removable media source, video recording is disabled.

To Start Recording:

1) First, insert a removable drive into a port connected to ARS.

2) To start and stop recording, press the **REC** button (at times labeled **REC SCR/REC CAM**) or use the **ALT+Y** (**ALT+U** for **REC SCR/REC CAM**) key command.

    ARS searches for a removable drive. Once located, the recording starts and the recording status icon in the upper left of the ARS screen flashes red.


    ALT:7750ft TGT LAT:+40.219113° LON:-104.979911° EL:4,952ft DIST:1.5M

    The **REC** button for the source recording also becomes red.

3) Pressing the **REC** button (**ALT+Y**) a second time ends the recording (**ALT+U** for **REC SCR/REC CAM**).

Video Playback Controls:

Use **Video Playback Controls** to pause and control live video, select different points in the recording, or speed up and slow down playback.
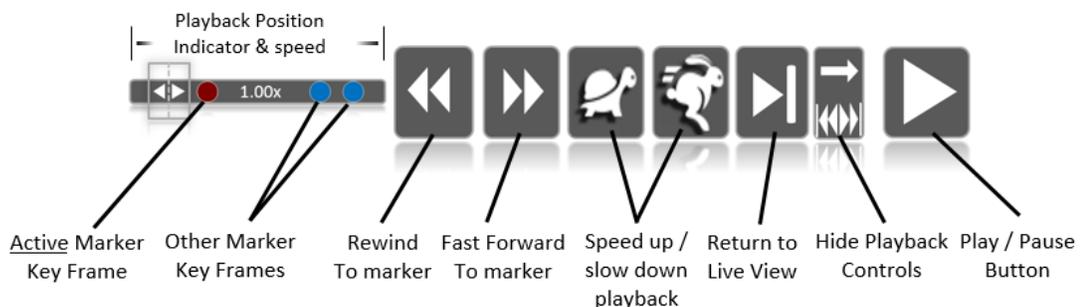
1) Use the playback speed, fast forward, or rewind buttons to control playback position.

2) To playback a different video, navigate to *Menu/Load Recording* and select the video from the list.

3) **CTRL+I** ends playback and returns to live video.

Video Playback Keyboard Commands

- **CTRL+S** through **J** = Incremental Rewind (see table below).
- **CTRL+W** through **U** = Incremental Fast Forward (see table below).
- **CTRL+ALT+A** = Slow down playback.
- **CTRL+ALT+Q** = Speed up playback.
- **CTRL+K** = Rewind to the start of the recording.

### Incremental Rewind and Fast Forward key combinations

Incremental Fast Forward		Incremental Rewind	
CTRL+W	3 seconds	CTRL+S	3 seconds
CTRL+E	10 seconds	CTRL+D	10 seconds
CTRL+R	30 seconds	CTRL+F	30 seconds
CTRL+T	2 minutes	CTRL+G	2 minutes
CTRL+Y	10 minutes	CTRL+H	10 minutes
CTRL+U	60 minutes	CTRL+J	60 minutes

Marker Navigation During Playback

The Playback Position Indicator also displays placed markers. A red circle indicates the active marker's timestamp. Blue circles indicate timestamps of inactive markers.

When markers are present, use the rewind and fast forward to marker buttons to move playback to that section of the video. To review recordings and marker data for post-mission analysis, use the following procedure:

1) Insert the removeable media with the desired recording and marker files.

2) Load the recording via *Menu/Load Recording*
   a. Playback icons now display. Markers do not display because they must be separately loaded into ARS.

3) Load the corresponding marker file via *Menu/Load Markers*.

4) Navigate markers during playback via the on-screen playback buttons or their corresponding keyboard shortcuts detailed below:
   a. **CTRL+Q** skips to next marker in playback
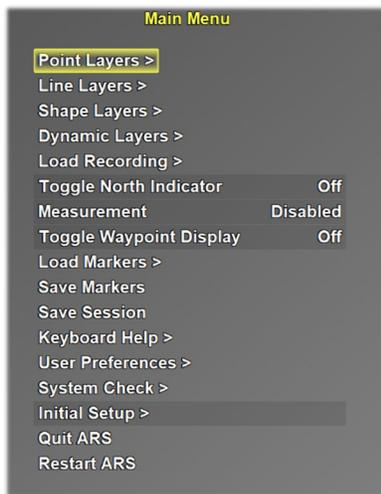   b. **CTRL+A** skips to previous marker in playback
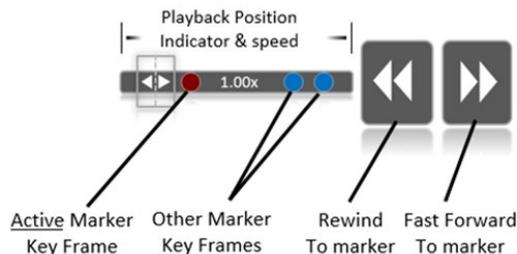
Recording Notes:

- One hour of HD video consumes roughly 4 GB of drive space: Plan drive capacity accordingly.

- Most consumer USB and SD removable drives use FAT32 file systems by default. For better performance, format drives to use an NTFS or exFAT file system. Removable drives may also need to be periodically reformatted to ensure maximum performance.

- When drives are connected, selecting a preferred drive for recording is configurable in *Menu/User Preferences/Recording/General Preferred Drive*.

- A configurable recording buffer records roughly 15 seconds prior to pressing **REC** button.

- For standard installations, ARS records only raw camera footage by pressing the **REC** (**ALT+Y**).

- For ARS installations configured with an auxiliary record option press **ALT+U** to record everything the operator sees including on-screen ARS data and displayed feature overlays.

- Video records in the resolution selected for the monitor, not the resolution of the camera.

- The default recording format is H264 video with AAC audio in a TS (Transport Stream) file. Additional video and audio encodings are available via the User Preferences > Recording menu if your video editing software is incompatible with this format.

- ARS can also record video in the following video file recording formats: M2TS, TS, and MTS

The On-Screen Menu

General Information

Main Menu

Point Layers >
Line Layers >
Shape Layers >
Dynamic Layers >
Load Recording >
Toggle North Indicator   Off
Measurement   Disabled
Toggle Waypoint Display   Off
Load Markers >
Save Markers
Save Session
Keyboard Help >
User Preferences >
System Check >
Initial Setup >
Quit ARS
Restart ARS

The ARS menu is accessed by pressing the **MENU** button (**M**). While in the menu, select features, layers, configure the system, and choose which items to show on-screen.

ARS displays information about the selected menu option in the lower right corner of the screen. Press the upper left **Back** button (**Backspace**) to return to the previous menu.

By default, changes to settings are auto saved and applied to ARS as soon as the selection is made. To have changes be not auto saved, navigate to *Menu/Initial Setup/Auto-Save Settings/Off*.

Pressing the **Esc** key or clicking the **X** button in the upper right of the menu screen closes the menu.

Point Layers

The Point Layers menu displays point information by selecting items to display on-screen. Displaying Point Layers is independent of selections made from the **OFF/STREET/PARCEL** overlay button, which hides street and address data but *NOT* items displayed under this option. Point Layer items in white are actively displayed on-screen, greyed out items are not.

Point Layers vary based on area and data availability but may include:

- Cities/Places
- Airports
- Parks
- Schools
- Antenna Structures
- Dams
- Golf Courses
- Hospitals
- Rail Stations
- Rest Areas
- Beaches
- Border Crossings
- Ferry Terminals
- Mines
- Tunnels
- Highway Exits
- Highway Mileposts
- Counties

Line Layers

The Line Layers menu selects lines or layers to display or hide from view. Displaying Line Layers is independent of selections made from the **OFF/STREET/PARCEL** overlay button. Line Layer items in white are actively displayed on-screen, greyed out items are not.

Line Layers vary based on area and data availability but may include:

- Airspace
- Rail Roads
- Water Lines
- Trails
- Cities
- Unincorporated areas
- County Outlines

Shape Layers

Shape Layers are shaded polygons indicating ground features in the *NAV* and *NIGHT* map modes. For Shape Layer items in white are actively displayed on-screen; greyed out items are not.

Shape Layers include items such as:

- Cities
- Unincorporated Areas
- Schools
- Parks

- Water
- Runways
- Buildings

Dynamic Layers

Dynamic Layers display persistent data layers such as aircraft and camera breadcrumbs, and camera areas viewed. Operators can also draw lines, perimeters, search patterns, upload, unload, and save data.

Aircraft Breadcrumb displays, formats, and saves the path the aircraft has traveled.

Camera Breadcrumb displays, formats, and saves the path the camera has traveled.

Camera Area Viewed paints the on-screen area already viewed by the camera. This feature is exceptionally useful in SAR scenarios for discerning areas already covered as well as identifying missed areas.
Camera Area Viewed also displays, formats, and saves the areas viewed by the camera.

With SPOI tracking, the line goes anywhere the camera does, no matter its motion or location. Camera Area Viewed differs in that it is smarter by accounting for two additional features before tracking the four corners of the video. For example, if the camera moves quickly, Camera Area Viewed stops tracking in these cases, because the video is no longer viewable.

Camera Area Viewed ensures the video is viewable based on the Feature Size setting within the Layer Options menu. As a result, Camera Area Viewed ensures the four corners are visible, with the defined feature size (1.5 meters by default) no smaller than three on-screen pixels.

As a result, if the camera is looking at something far like the horizon, or too zoomed out, Camera Area Viewed will stop tracking as this feature only tracks what is close enough to be seen by operators.

Using Camera Area Viewed, viewed areas are painted blue on the map when Min Feature Size requirements are met.

Other System Layers

Specific integrations with external products can create Dynamic Layers. Examples include AIS (vessel IDs), ADS-B (aircraft IDs), AVL (EMT & patrol vehicles), and direction finders. These layers only appear when generating data, and operators can show and hide layers as needed.

ARS auto-creates dynamic layers. Each layer type contains the following options:

Show	Displays the on-screen layer.
Hide	Hides the on-screen layer.
Save	Saves the layer to removable media. Files are saved as KML files (ARS and Google Earth compatible) or Shapefiles (ARS and ESRI compatible). Saved layers can be uploaded and displayed in ARS, Google Earth, ESRI, or other mapping applications.
Color	Adjusts the on-screen layer color.
Line Width	Adjusts the on-screen layer thickness.
Center	Centers the display on the layer.
Reset	Deletes the current layer and starts a new layer.
Disable	Stops recording and updating layer information.

Create New Layer

Create New Layer (**ALT+L**) displays operator-drawn points, lines, shapes, and search patterns on-screen. Use Create New Layer to outline a fire perimeter, draw a line for the camera to follow, highlight an area of interest such as an oil spill, or generate search patterns on-screen.

Create New Layer displays the layer menu in the upper left corner of the screen. Creating a custom layer auto-adds the layer to the Dynamic Layers menu with a default *yyyy-mm-dd-time* title. Selecting a layer in the Dynamic Layers menu displays the following options:

Show Displays the layer on-screen in video mode, map mode, or both.

Hide Hides the layer in all modes.

Save Saves layers to the removable drive. Operators *cannot* save layers without a connected removable drive. Layers are saved as KML files by default. The default layer file format is configurable in *Menu/User Preferences/Layer Options/File Format*.

Color Adjusts the color of the layer.

Line Width Adjusts the on-screen layer thickness.

Show Info Displays basic layer data such as features, perimeter, and area.

Vehicle Follow Follows the layer with the aircraft. The Waypoint Display shows a Course Deviation Indicator (CDI) for determining the lateral position of the aircraft relative to the layer. The CDI makes it easy for crews to correct course deviations. On-screen navigational data for following the layer is also displayed.

Camera Follow Follows the layer with the camera. The Waypoint Display shows a CDI for correcting course deviations. On-screen buttons for controlling the speed, direction, and pause capabilities of camera follow mode are also displayed.

Center Centers the display on the layer.

Rename Edits or adds a name to the selected layer.

Edit Edits the points of an existing layer. Use the **Move**, **Delete**, or **Name** buttons and select the point to make it active. Once changes are finalized, select **Done**.

Remove Deletes the selected layer from the system.

Lock Locks a layer so it is available after system shutdown.

Unlock Unlocks a layer so it is deleted after system shutdown.

Load Layer lists all available layer files on the connected media source. By default, layers use the naming convention: *Layer_Date-Sequential File Number*. Selecting a layer uploads the layer to ARS for on-screen display.

Unload All Custom Layers removes all custom layers from the system.

Load Recording
Load Recording loads recorded video from the connected media source for playback through ARS.

Toggle North Indicator
Toggle North Indicator (**C**) toggles the north indicator arrow, on, on with speed and direction, and off. Operators can also configure ARS to toggle the north indictor when using the laser range finder (LRF).

Measurement
Measurement (**V**) toggles the Speed and Distance Measurement tools, and a dynamic linear bar scale that scales according to camera zoom. For more details, refer to the corresponding sections of the manual.

Waypoint Display
Waypoint Display provides the crew with active marker navigational information. Toggling the *Waypoint Display* menu item to *On* (**W**) turns on the waypoint display overlay. This information gives the crew a navigational aid by displaying marker heading, aircraft speed, distance, and ETE to the marker location. The waypoint information is displayed as follows:

Waypoint Display

Selecting *On w/Arrow* shows the waypoint display with an on-screen arrow and overhead compass displaying the direction to the active marker as well as the azimuth where the camera is pointing.

Locking Markers in the Waypoint Display
Lock Marker (**E**) enables the operator to lock the waypoint display's data to a specific marker. This feature is helpful when placing additional markers unrelated to the destination marker. Locking the destination marker provides the crew with the correct navigational data even when placing new markers.

Pressing the **Target** button (**ALT+E**) in the lower right corner of the waypoint display sets the active marker to the locked marker. This feature is useful for quickly viewing the locked marker when focused on the active marker or other locations.

Lock marker   *Go to locked marker*

Pressing or clicking the **Lock** button (**E**) a second time unlocks the marker in the waypoint display.

Load Markers

Load Markers uploads previously saved markers into ARS. Once selected, a list of all saved marker files on the connected media drive displays on-screen. After selecting a file, markers are displayed on-screen and are also available for search via the **Search** feature.

Save Markers

Save Markers saves the current markers to the removable media source to transport to an ARS Ground Station, external mapping programs such as Google Earth and ESRI, or re-uploading into ARS.

> ✔ **Note:** Markers are temporary and deleted after system shutdown. Saving Markers prevents marker deletion after system shutdown.

Markers are saved in a KML file by default. Adjust the default file format in:
Main Menu/User Preferences/Marker Options/File Format.
- *KML*   KML format is used with ARS and compatible with Google Earth.
- *Shape*   Shape File format is used with ARS and compatible with ESRI.
- *GPX*   GPS Exchange format is used with ARS, Google Earth, and various GPS devices.

Keyboard Help

Keyboard Help displays a list of Keyboard Shortcuts available in ARS.

User Preferences

User Preferences displays the user-preference configuration options in ARS.
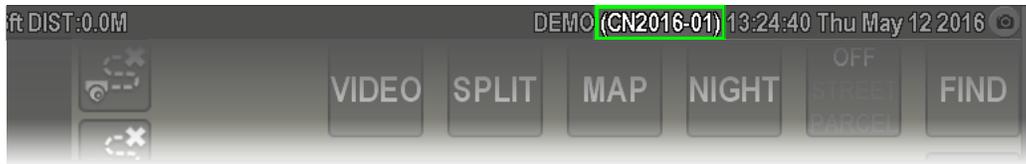
Profiles:

ARS uses a single configuration that applies to all users by default. Changes made in the *User Preferences* menu section are applied globally and available to all ARS users.

Profiles allow operators to tailor system settings to suit individual preferences or mission requirements and save them as a distinct profile. There is no limit to the number of profiles stored in ARS. Operators can create multiple profiles for various mission settings and export profiles to other ARS installations.

Steps for creating a new profile:
1) Access the *Profiles* feature under the *User Preferences* menu.

2) Choose *Create Profile* and name the profile. Press **Enter** to save the profile.

3) Make desired changes to the preferences and settings.

4) Save changes by selecting your profile in *Menu/User Preferences/Profiles/Profile Name* and pressing *Save*.

User preference changes made with an active profile must be re-saved to be associated with the active profile. The upper right on-screen text (next page) displays the profile name when a profile is active.

Profiles can be saved at any time. However, loading or unloading profiles _requires_ a system restart. Operators can also apply password protection protecting their profiles from unauthorized access.

> **Note:** Unload active profiles **before** changing settings in the _Initial Setup_ menu in ARS. Use the _Initial Setup/Advanced/Save Default Config_ menu option to save changes before re-loading.

Recording
Recording allows control over various aspects of recording operations within ARS. Operations include formatting removable media, controlling the recording indicator light, setting duplicate recordings, and setting preferred primary and secondary drives for recording primary and AUX video.

Format Media
Format Media formats drives to NTFS, FAT32, or exFAT for use with ARS. SHOTOVER Systems recommends the NTFS format for recording video when using Microsoft Windows. For compatibility with Apple products, we recommend exFAT file format. Removable media should be periodically reformatted to ensure maximum performance.

> **Note:** Formatting a drive deletes _everything_ from the selected drive.

Pulse Light
Pulse Light controls the behavior of the record light indicator in the upper left corner of the screen.

File Extension
Allows the operator to choose the file extension used by ARS. Options include .TS, MTS, and .M2TS

Recorder Duplicate Recordings
ARS can record up to three channels of video. These options output two identical copies of recorded video to two separate drives when enabled. Video sources include primary, AUX, and others.

Preferred & Secondary Drives
General Preferred Drive selects the preferred drive for storing ARS recorded video. Additional drives are configurable based on available video sources.

Backup Drive
ARS allows a backup drive to be specified and used if all other drives are full or unavailable.

Drive Identification Method
The Drive Identification Method allows different methods for ARS to display the drive letters or path/port.

Auto Record & Auto Record AUX
Set to *OFF* by default. When set to *DETECT* or *ALWAYS*, ARS will begin recordings based on the selected parameter. When set to VASCAR, recordings of the speed measurement action will be saved when the *FINISH* button is selected in the Speed Measurement Window.

Video PIP
PIP Location
PIP Location configures the on-screen picture-in-picture window location. For detailed information on additional PIP features, refer to the corresponding section of the manual. PIP locations include:

- Custom
- Lower left
- Upper left
- Upper right
- Lower right

Coordinate System
Coordinate System selects the preferred coordinate system displayed in ARS. Operators may select *Decimal*, *Deg-Min-Sec*, *MGRS*, *GARS*, and others. Contact SHOTOVER Systems for coordinate system availability.

Units
Units defines the units of measure in ARS (restart required). Configure Ground Units, Minor Ground Units, Altitude Units, Air Units, Area Units, Pattern Units, and Measurement and Direction Units. Units include:

- Miles (M)
- Kilometers (km)
- Feet (ft)
- Meters (m)
- Yards (yd)
- Nautical Miles (NM)

Measurement Direction
Configured in the Units Menu and defines heading styles for distance measurement. Operators may select:

- Cardinal
- True bearing
- Magnetic Bearing
- Hours ("7 o'clock", etc.)

Waypoint Mode
Waypoint Mode toggles the information format within the on-screen waypoint display. Operators can choose Camera Elevation and Azimuth, or Range (ETE) to the active marker.

North Indicator
North Indicator adjusts the north indicator crosshair format displayed in Video Mode. The North Indicator appears at the center of the ARS screen and can be toggled via pressing lower-left corner, Menu, or **C** key.

> **Note**: The speed readout near the cardinal direction indicator on the North Indicator shows the speed of the reticle across the ground, *not* necessarily the speed of the target.

Size Mode	*Fixed Length in World* dynamically <u>sizes</u> the on-screen North Indicator as <u>twice</u> the tip to tail radial distance. The North Indicator expands when zooming in and contracts when zooming out. Setting *Radius* to 2.5 meters means the North Indicator remains 5 meters long regardless of zoom.

Same Size on Screen dynamically <u>scales</u> the measured radial length of the North Indicator regardless of camera's zoom level. Zooming in or out scales the distance to match the North Indicator's on-screen size while the North Indicator's on-screen overlay size remains unchanged (*pictured below*). |
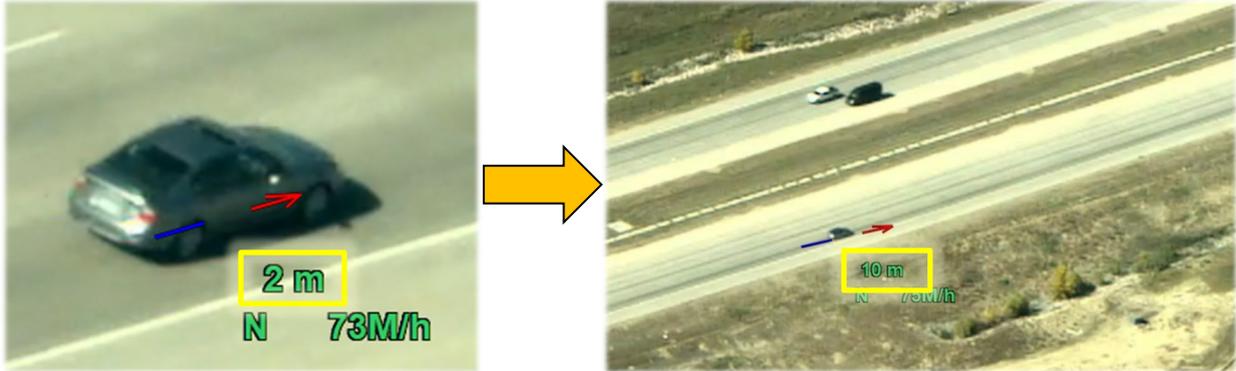
*With Same Size on Screen enabled, the North Indicator pictured on the <u>left</u> has a 2-meter radius and a 4-meter length. After zooming out (right), the North Indicator's **on-screen size** is unchanged and it now represents a 10-meter radius and a 20-meter length.*

Appearance	**Appearance** toggles the appearance of the North Indicator. Options include: • *XYZ*: X, Y, and Z axes (N, S, E, W, and Up). • *Arrow*: A simple arrow pointing north. • *Transparent Arrow*: A thick transparent arrow pointing north. • *Circle*: A circle with a measured radius and red pointing north.

Arrow (with speed)	*Transparent Arrow*	*XYZ Arrow*	*Circle*

Radius	When using *Fixed Length in World, Radius* statically defines the North Indicator's center to edge length regardless of zoom. For example, when set to 2.5, the center-to-edge length of the North Indicator is always 2.5 meters with 5 meters of total length.

When using *Same Size on Screen*, *Radius* defines the North Indicator's on-screen overlay size and its length scales with zoom. Since *Same Size on Screen* dynamically scales distance without changing the North Indicator's size, *Radius* only defines the North Indicator's on-screen size. |
| **Opacity** | Changes the North Indicator's opacity. Ranges from *10%* to *100%*. |

Show Street Displays the nearest street next to the North Indicator's direction and speed. Operators may select from the following:

- *Off*: Does not display the nearest street, only speed and direction.
- *Auto*: Displays the nearest street respect to true north (0 to 360).
- *Auto + Speed*: Displays streets, but only when going by too fast.
- *Always*: Always shows the nearest street with the North Indicator.

The North Indicator's display with Show Street set to Always. Note that highway I-25 is displayed next to the North Indicator's heading and speed.

Altitude Display

Altitude Display controls the display of aircraft altitude in the upper left corner. Options include: *None*, *AMSL*, *AGL*, or *Both*.

Distance Display

Distance Display controls the display of distance to the target in the upper left corner. Options include: *Ground Distance*, *Slant Range*, *Both*, or *none*.

Marker Heading

Marker Heading sets the reference heading to the active marker. Options include *relative to Aircraft*, *True North*, *Magnetic North*, *Aircraft Verbose*. (uses left/right with reference the aircraft's nose, ex: "40° left"), *Hours* (10 o'clock), and *Aircraft 360* (using the aircraft's nose as the 360° reference).Marker Heading also affects the heading value shown in the marker information display at the bottom right side of the screen.

Waypoint Heading

Waypoint Heading alters the display of the heading to the locked or active marker, but only in the waypoint display. Options include *relative to Aircraft*, *True North*, *Magnetic North*, *Aircraft Verbose*. (uses left/right with reference the aircraft's nose, ex: "40° left"), *Hours* (10 o'clock), and *Aircraft 360* (using the aircraft's nose as the 360° reference).

Mouse Cursor

Mouse Cursor toggles the on-screen cursor visibility on systems equipped with a mouse or trackpad. For most touchscreen installations, this setting is off by default.

Mouse Cursor Timeout

Mouse Cursor Timeout adjusts the time it takes for the mouse cursor to disappear from the screen after an operator defined number of seconds (5 seconds by default).

General Interface

The General Interface settings menu allows the position of movable on-screen items like the speed limit display or layer info window to be saved or reset. By selecting *Speed Limit On*, ARS will display the speed limit for certain major roads. Please note that speed limit information is not available everywhere. A system restart is required when this option is enabled or disabled.

ARS Crosshairs

Toggles the crosshair display on or off. ARS Crosshairs are independent of camera-based crosshairs. Operators can change the appearance, size, color, and width of the crosshairs.

Search Options

Search Options configures the actions ARS takes when a location in entered via the search feature.

Post-Search — Configures ARS actions (what will display) *after* entering a location via search.

Stay on Current directs ARS to remain centered on the current display mode.

Video switches to Video Mode centered on current camera location.

Target switches to Map Mode centered on target (camera center). Target is the system's default setting.

Search Result switches to Map Mode centered on the location entered.

Aircraft switches to Map Mode centered on aircraft location.

Split/TGT, Split/MRKR, Split/ACFT, switches to a split window with Video Mode and the corresponding Map Mode.

Search Center — Adjusts the proximity of the camera target or aircraft when entering a search location. When searching, there is no need to enter the city, county, or state of that location.

Enter the street address or business name and ARS lists the matching locations in proximity to either the camera target or aircraft location.

Coordinates Numpad — Toggles the on-screen number pad display when entering coordinates.

Reset Search Tab — Sets *Basic Search* as the default search type when accessing the search feature. When disabled, accessing the search feature displays the previously used search type. For example, if the previous search used the *MGRS* type, accessing *Search* again displays the *MGRS* type until another search type is chosen.

Reset Search Fields — Controls whether text from previous searches remains in the search field.

Auto Geopoint — Controls the behavior of the camera when using search. If set to on, the camera automatically slews to the search result (geopoint).

Search Radius — Allows operators to configure the searchable radius when using the search feature. For example, if set to 160,934 meters (100 miles), only results within a 100-mile radius are shown.

Keep Search Markers — Places markers generated from Search in the *Keep* category. Enabling this option means that search results will require verification prior to deletion.

Video Options

Video Options configures how the split screen and the video is displayed.

Split Location	Determines the video-display location when enabling split-screen. Options include the *Left*, *Right*, *Bottom*, or *Top* of the screen.
Split Mode	Determines the split screen layout. Choose *Side by Side*, *Map* or *Video Inset*.
Split Offset Left	Determines the split inset window distance from the left side of the screen.
Split Offset Bottom	Determines the split inset window distance from the bottom of the screen.
Split Scale Width	Adjusts the amount of screen taken up during split-screen mode. Enter values as a decimal value between 0 and 1. For example, 0.25 allows the split-screen 25% screen width.
Split Scale Height	Determines the height of the split-screen for inset mode only. Enter values as a decimal value between 0 and 1. For example, 0.25 allows split-screen 25% of the screen height.
Split Zoom	Determines if the video will be *Centered* or *Zoomed* when displayed in split screen. Centered shows the entire video image in the pane. Zoomed shows a zoomed video image, trimmed to fit the pane.
Preferred Zoom	Defines the preferred zoom level for Video Mode. Set to 1 fits the screen, <1 zooms in, and >1 zooms out. Adjusting this setting shows more or less of the camera symbology on-screen and allows the default to be selected.
Preferred Split Zoom	Adjusts the default zoom level for Split-Mode. Set to 1 fits the screen, < 1 zooms in, and >1 zooms out. Split Zoom *overrides* this setting.
Black on Video Loss	If loss of the video signal occurs, the Black on Video Loss 'On' option will show a black screen instead of the last received frame of video.

Map Options

Map Options configure how map items displayed on-screen.

|	
Startup View	Startup View changes the default startup view of ARS. Select from *Video*, *Map* (centered on the target, marker, or aircraft), or *Split Screen* mode.
Lock Map	Lock Map prevents panning and dragging the map unless in Map User Mode.
Overhead Compass	Overhead Compass turns the compass display on or off (pictured right).
Heading Line	Heading Line turns the heading display on or off. Turning Heading Line on displays a black line in front of the aircraft showing its current heading.
Camera Line	Camera Line displays a line drawn from the aircraft to the camera target.
Target Reticle	Target Reticle displays a secondary reticle on the map indicating the camera target. The value scales the size of the target reticle. Note that the default value is 0.05, and 0 disables Target Reticle.
Map Lines	Map Lines configures the lines displayed on-screen. Depending on the selection(s), the system can display the following: • *Marker, Vehicle, and Nearest Street* • *Marker Only* • *Marker and Vehicle* • *Off* to hide all lines
Map Scale	Map Scale controls the display of the map scale indicator. Selections include *Map* or *Video* only, *both Map and Video*, or *Off*.
Aircraft Icon	Aircraft Icon opens a sub-menu of icon settings described in detail below.
Show Vehicle Icon	Show Vehicle Icon toggles the on-map vehicle icon on or off.
Show Vehicle 3D Model	Show Vehicle 3D Model toggles a 3D model image vehicle icon on or off.
Vehicle 3D Model Style	Vehicle 3D Model Style adjusts the on-screen vehicle to either a *Fixed Size In World* or *Same Size On Screen*. Fixed size in world scales the icon size with the zoom level while Same Size on Screen has a fixed size regardless of zoom.
Vehicle 3D Model Size	Vehicle 3D Model Size sizes the on-screen vehicle to suit operator preference.
Move Map Ahead	Move Map Ahead moves the map in front of the vehicle icon allowing operators to see more of the map. Adjustments center to the bottom of the icon, and setting values range from 0 to 1.
Aircraft Icon Offset	Aircraft Icon Offset centers the vehicle-icon based on vehicle-speed. Values range from 0 to 1, where 0 disables the setting, and 1 is one second ahead.

Map Projection	*Map Projection* (**Alt+F**) determines how the camera footprint is represented on-screen.
	Video Projection displays the footprint as a projection of the video on screen.
	Footprint Outline displays the outline of the camera footprint on-screen <u>without</u> video.
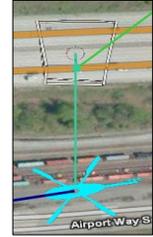
Video Projection　　*Footprint Outline*

✓ Map projection can also be cycled by clicking on the gimbal icon in the lower right corner of the ARS display.

Split Map Projection	Toggles camera projection Split Screen Mode on or off.
Camera Frustum	Toggles the camera target display-style on the map. When on, displays a cone-like depiction of the camera target. If off, only the video footprint is shown.
Zooming	Opens a sub-menu of zoom settings described in detail below.
Smooth Zoom	Determines zoom action when entering locations. When on, smooth zoom zooms out to move across the map and smoothly zooms in again after entering a location via the Find feature.
Default Map Height	Consists of two settings, *AGL* and *Aircraft*: *AGL* – Sets the default map height measuring from the ground. *Aircraft* – Sets the default map height measuring from the aircraft. Both settings measure height in meters. Additionally, Aircraft Height adjusts the default zoom level only when AGL Height is set to zero.
Default Auto Zoom	Toggles autozoom on or off, overrides the *AGL* and *Aircraft* height settings.
Auto Zoom Mode	Toggles between two autozoom settings, *POI Center* and *Halfway*. POI Center centers autozoom on the camera target, and Halfway centers autozoom halfway between the camera target and aircraft.
Split Screen Autozoom	When set to *On*, split TGT mode will attempt to zoom to the field of view.
Aircraft Orientation	Orients the map when in aircraft center mode. Select from *North Up*, *Course Up*, *Target Up* or *No Change*.
Target Orientation	Orients the map when in target center mode. Select from *North Up*, *Course Up*, *Target Up* or *No Change*.

Marker Orientation   Orients the map when in marker center mode. Select from *North Up*, *Course Up*, *Target Up* or *No Change*.

Aircraft Always Up   Orients the map Aircraft Up despite map mode or state.

Geopoint Behavior   Configures ARS's Geo-pointing behavior. Options include:
- *Stay on Current*: ARS remains centered in its current mode.
- *Video*: ARS switches to Video Mode centered on camera location.
- *Target*: ARS switches to Map Mode centered on camera target.

Video Off Behavior   Determines ARS's behavior when the video signals are lost or turned off. Choose to stay in Video Mode switch to Map Mode.

Streets/Labels Options

The Streets/Labels menu configures how items are shown on-screen. Note that adjusting any of the following settings _requires a system restart_.

Lines Opacity	Changes the transparency of the overlaid lines. Enter a value from 0 to 1 where 0 is transparent, and 1 is opaque. For example, entering 0.5 is halfway between transparent and opaque.
Label Opacity	Changes the transparency of the overlaid labels. Enter a value from 0 to 1 where 0 is transparent, and 1 is opaque. For example, entering 0.5 is halfway between transparent and opaque.
Overall Opacity	Adjusts ARS's global opacity where 0 is transparent, and 1 is opaque.
Outlines	Enables or disables road outlines based on viewing needs.
Font Size	Scales font size up from the default setting.
Hinged	Aligns street labels with their directional orientation in Map Mode.
Video Disable Hinged	Aligns street labels with the camera's orientation in Video Mode. When Enabled, street labels align with the street's physical orientation (pictured below).

Street Label Appearance with Video Disable Hinged Enabled   _Street Label Appearance with Video Disable Hinged Disabled_

IR Color Switch	When enabled, this option switches the colors used for the road overlays for increased visibility operating in IR mode.

Marker Options

The Marker Options menu configures how marker labels are displayed and what information is saved.

File Format	Determines the default file format when saving markers. Choose from *KML*, *Shape*, or *GPX* file formats.
Marker Labels	Configures how markers are labeled. • *None*: Displays <u>only</u> points, <u>no</u> labels. • *Named Highlighted*: Display a label for a <u>*named-active*</u> marker • *Named All*: Displays labels for all <u>*named*</u> markers • *Highlighted*: Display labels for all <u>*named*</u> and active markers. • *All*: Display labels for <u>*all*</u> markers.
Saved Markers Projection	Saved Markers Projection allows operators to change the map projection used in ARS. Choose from Geographic, UTM, Alberta 10TM, or OS Grid.
Info Prompt	Automatically displays the keyboard prompting operators to name their markers and provide additional information.
Search Range	Defines the distance (in meters) from the marker to the nearest POI.
Auto Screenshot	Takes and saves screenshots when placing markers.
Additional Coordinates	Displays additional coordinate sets when activating the *Additional Information* overlay via the bottom right indictor icon (**A**).
Waypoint Isolation	Allows the operator to show direction indicators and information only when markers are locked and being used as a waypoint. <u>*No*</u> direction information will be provided for <u>*unlocked*</u> markers. *Waypoint Isolation Unlock Action* determines ARS's action after unlocking a waypoint. Operators can choose None for no action, or Center on Aircraft.
Waypoint Isolation Unlock Action	Specifies the action that occurs when a locked waypoint is unlocked.
Waypoint Autolock	Automatically locks markers as waypoints placed via Search. When off, the operator must manually lock markers as waypoints. *On If Nothing Locked* locks search-result markers automatically, provided nothing else is already locked. *Always* auto-locks each search result marker as a waypoint.
Display Time	Toggles the time to display in the marker information located in the bottom right corner. Operators can choose from Delta or Actual**.**
Default Icon	Sets the default icon for markers in ARS
Selectable Icons	Choose which icons are displayed in the marker icon selection toolbar.

Layer Options

Layer Options configures parameters for automatic layer following.

Orbit Helper Angle	Calculates orbit based on the desired angle degrees and current AGL. When set to 0, ARS uses *Orbit Helper Radius* instead.
Orbit Helper Radius	Adjusts the radius of the orbit helper in nautical miles. *Orbit Helper Angle* overrides this setting when turned on.
File Format	Sets the default file format for saving dynamic layers (*KML, SHP, GPX*).
Hide User Layers	Hides layers in Video Mode and shows layers in Map Mode.
User Layer Line Width	Specifies the width of the line of dynamic layers (*5 by default*).
Vehicle Follow Distance	The distance threshold that advances to the next waypoint when exceeded. Primarily used for aircrafts approaching waypoints in large patterns (meters).
Camera Follow Distance	The minimum distance threshold that a location of interest must be within before ARS slews the camera to the location of interest (*meters*).
Height	Adjusts the ground height offset in meters. For example, when following a powerline that is 5 meters above ground level, enter 5.
Zoom Speed Reduction	Determines zoom speed changes with respect to zoom levels on camera following. Set 0 to disable and 1 for linear.
Fixed Speed	Defines a set speed in <u>*meters per second*</u> when in one of the follow modes.
Speed Increment	Adjusts the amount of speed in <u>*meters per second*</u> added or subtracted with each press of the corresponding buttons in follow modes.
Hug Ground	Determines whether to always follow the ground and offset or to interpolate between points.
Camera Follow	Adjusts the type of line following. Choose Moving for preset speed in <u>*meters per sec*</u>ond or Nearest for aiming the camera at the nearest POI.
Search Source	Determines where to start the search in camera follow mode. Choose from starting at the *vehicle* or at the *camera*.
Mode	Allows the follow software to be tested. For standard use set to Aircraft.
Min Feature Size	The minimum size (meters) for highlighting a viewed area (on page 34).
Auto Record Following	Starts recording once a follow mode is entered.
Editor Cursor Threshold	Determines the cursor's distance from a feature before selecting it.

Video Playback

Video Playback allows operators to choose to broadcast and track recorded vehicles. Select *Live Vehicle Only* when using ARS in an aircraft, and *Recorded Vehicle Allowed* when using a ground station.

Screenshots

Screenshots allows operators to configure system defaults when creating and saving screenshots.

Format	Configures the default file format when saving screenshots. Operators can choose from *PNG*, *JPEG*, *BMP*, *TIF*, *NITF*, or *PDF*
HUD	Defines the amount of information displayed on a captured screenshot. *Raw*: Hides all ARS-related data and captures the <u>camera's native resolution</u>. *Minimal*: Hides some ARS-related information, only certain information is displayed on the screenshot, including overlays and layers. *All*: Shows all ARS information and captures the <u>screen's resolution.</u>
Metadata File	Configures the default metadata files for screenshots. Choose *KML* or *None*.
Metadata Name	Allows the operator to assign a name to be used by programs like Google Earth, etc.
Container	When selected, all screenshots will be grouped into a KMZ container file.
VASCAR Auto	Automatically captures a screenshot when placing markers during Speed Measurement.
Auto Marker	Automatically places markers on-screen when taking screenshots. This option also allows operators to easily review screenshots while airborne. Screenshot review can be accessed using the dedicated icon in the additional marker info window as shown below. Within the review window, operators can control various settings for display of the screenshot.

Screenshot review

JPEG Quality Determines the compression quality of JPEG and JPEG compressed TIFF files. Choose from *Low*, *Medium*, or *High*.

GeoTIFF Compression Configures the GeoTIFF compression algorithm. Operators may choose from *JPEG* or *LZW*. Note that JPEG GeoTIFF compression produces smaller file sizes but can sometimes have visual artifacts. LZW produces larger files but with no visual artifacts.

GeoTIFF GCP Density Configures the ground control point density for orthorectifying images. Operators may select *Low*, *Medium*, or *High*. Low is the fastest but least accurate while High is the slowest but most accurate.

Email Settings

Email Settings configures the email settings within ARS. Settings include:

Screenshot Drawing   Allows image-annotation prior sending the image via email.

Active Maker   Automatically attaches the active marker to an email.

Marker Format   Determines the active maker file format attached to an email. Operators my select from *KML*, *SHP*, or *GPX* file formats.

Address Book   Provides a place for operators to store frequently used email addresses. This option brings-up the on-screen keyboard enabling email addresses made and stored. Operators can also manage default settings for each contact, such as the subject and message body. Configure contacts as default for all emails sent through ARS or removed from this menu.

SMTP Settings   Configures the desired outgoing email server.

AHRS Settings

AHRS configures altitude, heading, and reference system settings for ARS (if integrated).

Scale   Configures the size of the AHRS display.

Position   Configures the location of the AHRS window.

Transparency   Configures the transparency of the AHRS background.

Units   Configures the AHRS display units. Operators can configure display units for outside air temperature, air pressure, and ground speed.

System Check

System Check allows operators to validate the operation of ARS. System Check displays error and fault details in this location if any are present. Clicking on a warning or advisory message displayed in the lower left of the ARS screen displays details about the error.

Initial Setup

Initial Setup configures, calibrates, and troubleshoots the system. ***Once your system is configured, items in this menu should not be changed unless directed by SHOTOVER Systems Support.***

Save Settings

Save Settings saves the current settings configuration as the global system default.

Auto-save Settings

Auto-save Settings saves any menu changes automatically when exiting from the menu. If set to off, ARS settings will not be saved unless the operator manually presses *Save Settings*.

Backup Time

Backup Time defines time intervals for backing up data to prevent data loss in the event of an unexpected loss of mission power or unintended system restart. Enable Backup Time via the Initial Setup menu and configure a time interval for backups. SHOTOVER Systems recommends a minimum value of 120 seconds. When enabled, the state of the ARS unit – including vehicle paths, dynamic layers, markers, and data is backed-up to the removable drive and can restorable upon system restart.

Regional Customer Settings

Regional Customer Settings allows entry of information for display based on the areas of operation. Note that several of these settings will also *require* a system restart

Save Default Location	Saves the current active marker as the default ARS startup location. After receiving active GPS, the location displays on-screen.
Select Country	Selects the country where ARS is operated.
Agency Name	Displays the agency name in the upper right corner.
Tail Number	Sets the tail number and defines various data export prefixes.
Recorder Prefix	Determines prefix used in video recordings.
Time Offset	Adjusts the UTC/GMT offset within ARS. Time Offset titles video recordings, screenshots, and other data (daylight savings not included).
Auto Time Offset	Automatically sets the time offset based on current location.
Auto Time Zulu	Automatically pulls the current time from GPS time for the entire system.
Aircraft Type	Configures the vehicle icon displayed in ARS. Operators can choose: *Helicopter, Airplane, Blimp, Boat, Predator, F-16, Global Hawk, or Car*. ARS automatically restarts after making changes to this setting.

Configuration Mode

Configuration Mode determines how ARS registers key system components and should not be changed unless _specifically directed_ by SHOTOVER Systems.

VASCAR Min Distance

VASCAR Min Distance determines the minimum distance required for valid speed-tracking. Once this distance is exceeded, the speed in the speed management display changes from red to green.

VASCAR Min Accuracy

VASCAR Min Accuracy determines the minimum accuracy percentage required for valid VASCAR measurements. Operators can enter a percentage ranging from 1 to 99.9.

VASCAR Comment Prompt

VASCAR Comment Prompt shows an on-screen keyboard that allows the operator to enter free-form information about the speed measurement session or infraction.

Admin Password

Admin Password configures the password used to lock the initial setup menu in ARS.

Audio

Audio consists of two settings, _Startup Mute_ and _Auto Mute_. Startup Mute mutes microphones on system startup. Auto Mute mutes the microphone when not recording, so no audio is buffered in pre-roll. An optional user interface button can be displayed to allow the operator to manually mute/un-mute recorded audio.

Touch Screen Controls

Touch Screen Controls enables or disables touchscreen support in ARS. If not using a touch screen, ensure this option is disabled. ARS automatically reboots before changes take effect.

Gimbal Elevation

Gimbal Elevation determines if gimbal elevation is relative to the gimbal or relative to the world.

Lower Left Corner Action

Lower Left Corner Action determines ARS's action when activating the lower left screen corner. Options include _Show Ownership Information_, _Toggle North Indicator_, and _Additional Info_. Show Ownership Information displays ownership information from loaded parcel data in ARS. Toggle North Indicator toggles the north pointer off, arrow north, and arrow north with speed and direction. Additional Info displays additional information such as the counties and radio frequencies.

Calibrate Deviation

Calibrate Deviation calibrates the VASCAR calculations when using a camera supplied IMU as opposed to an external IMU.

Laser Behavior

Laser Behavior determines how ARS responds when firing the laser. Operators can choose to:
Do Nothing, _Add a Marker_**,** or _Cycle Layers_.

Transmitter Threshold
Transmitter Threshold configures an AGL threshold for shutting off downlink (meters, 0 disables)

Calibrate Optical Center
Calibrate Optical Center allows completion of the calibration procedure. For full functionality, see the corresponding Calibrating Optical Center section.

Calibrate Payload to Sensor
Calibrate Payload to Sensor allows completion of the calibration procedure. For full functionality, see the corresponding Calibrating Payload to Sensor section.

Calibrate FOV
Calibrate FOV allows completion of the calibration procedure. For full functionality see the corresponding Calibrate FOV section.

Diagnostics
Diagnostics is a trouble-shooting tool, only set when directed by SHOTOVER Systems Support.

Save Diagnostics
Save Diagnostics downloads the diagnostics page to removable media (USB or SD) so it can then be saved or emailed to SHOTOVER Systems Support for aid in troubleshooting.

Advanced
Advanced determines the DHCP service for the sensor, the selection of the turret, INS and Interface, selection of command mode, and arms and lever arms and offsets.

SHOTOVER Systems does _NOT_ recommend making changes in this menu without direction from SHOTOVER Systems Support.

Quit ARS
Quit ARS closes ARS. Once the software is closed, click the ARS icon on the desktop to reopen ARS.

Restart ARS
Restart ARS closes and restarts the system. Restart ARS is useful when changing menu items that require a reboot, such as resetting the units of measure.

Dynamic Layers

ARS allows for a wide range of layers to be selected, imported, created, and drawn on-screen. These layers come in several types. Dynamic layers are persistent data layers such as an aircraft's flight path, camera path, and camera areas viewed, which can be displayed or downloaded.

Aircraft Breadcrumb
Aircraft Breadcrumb displays, formats, and saves the path the aircraft has traveled.

Camera Breadcrumb
Camera Breadcrumb displays, formats, and saves the path the camera has traveled.

Camera Area Viewed
Camera Area Viewed paints the on-screen area already viewed by the camera. This feature is exceptionally useful in SAR scenarios for discerning areas already covered as well as identifying missed areas.

Camera Area Viewed also displays, formats, and saves the areas viewed by the camera.

| Aircraft Breadcrumb | Camera Breadcrumb | Camera Area Viewed |
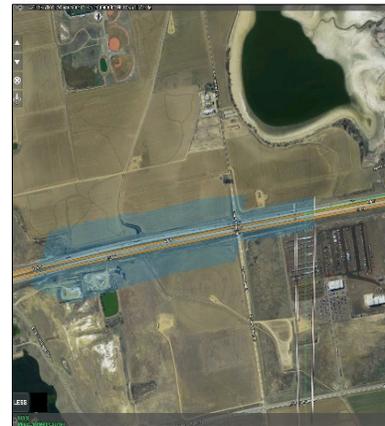
Aircraft Breadcrumb   *Camera Breadcrumb*   *Camera Area Viewed*

Orbit Helper
Orbit Helper provides crews with a visual indication of optimal orbits around camera targets. The desired radius can be a factor of the optimal downward camera angle and the desired standoff distance from / slant distance to the target.

To set up Orbit Helper, the operator should first set their desired radius in the by navigating to *Main Menu/User Preferences/Layer Options/Orbit Helper Radius*.

Next, choose the option to show the orbit helper via the Dynamic Layers menu. Display Orbit Helper on views for the top-down map, live video, or both.

Once the Orbit Helper circle is visible, the pilot need only to fly the profile of the layer outlined on the map or video mode, whichever is visible at the time.
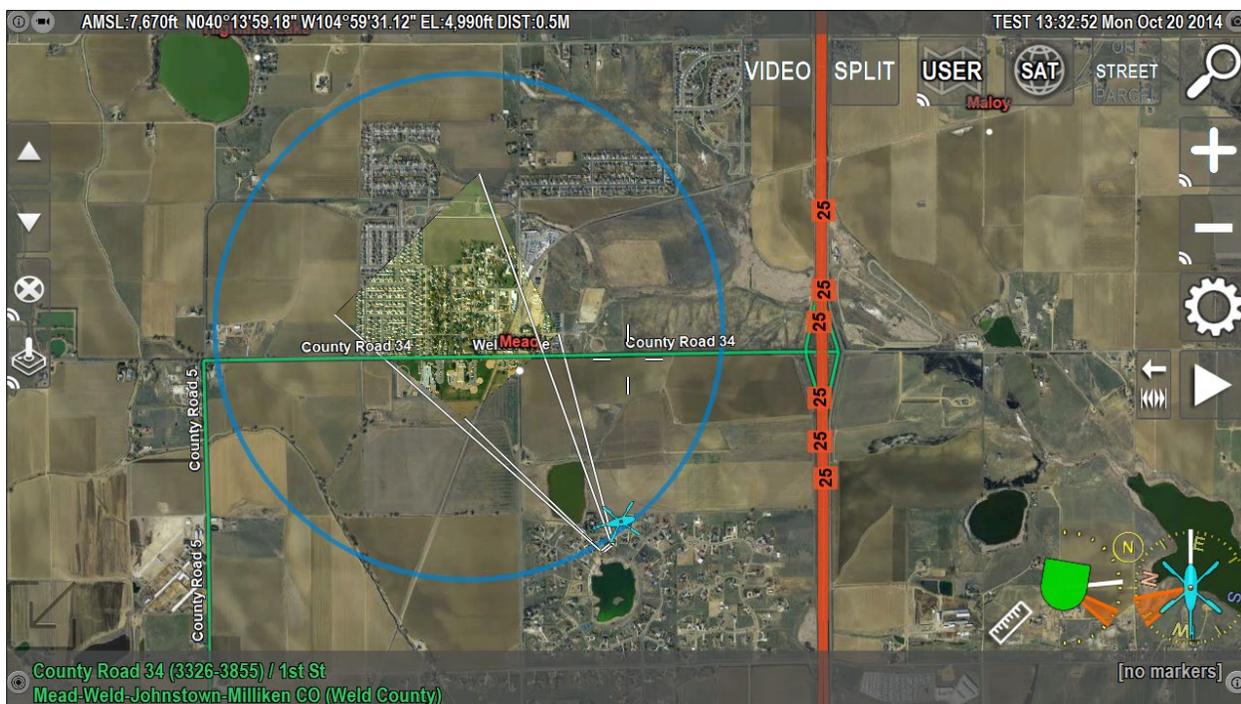
The operator has enabled Orbit Helper and the aircraft is tracking around the orbit-helper orbit (outlined in blue).

Each of these layer types have the following available menu options:

Show/Hide	Displays or hides the layers selected on-screen.
Save	Saves the layer to the removable media. Operators may select from file formats including *KML* (ARS and Google Earth compatible), *Shape* (ARS and ESRI compatible), and *GPX* (ARS, Google Earth, and various GPS devices). Once saved, layers can be uploaded and displayed in ARS, Google Earth, ESRI or other mapping applications.
Color	Formats the layer's on-screen color.
Line Width	Adjusts the on-screen layer thickness and ranges from 1 to 10.
Center	Centers the Map Mode view on the Orbit Helper orbit.
Reset	Deletes the current layer and begins a new one.
Disable	Stops recording and updating layer information.

Creating New Layers

Create New Layers is available in the Menu (**ALT+L**) and allows creation and display of points, lines, shapes, and search patterns. Creating a layer displays information about that layer in the bottom left of the screen.

Layers not saved are cleared from the system on shutdown. Layers can be saved to an external drive or locked in the system so that they can be available after shutdown.

When selected, the layer editor bar displays in the upper left corner of the screen. Some buttons have multiple functions and selectable by pressing the corresponding button.

Layer Editor Buttons

	RESET	Deletes all features in a layer and resets the layer creation process.
	NEW	Click on-screen to create points for drawing new features. The type of layer is dependent on the *Shape/Line/Point/Free/Trace* settings.

Layer Creation Tools

	MOVE	Create new points or move points in an active feature.
	DELETE	Deletes a point or line segment in the active feature.
	NAME	Adds a name or label to a feature.
	COLOR	Changes the color of a feature.
	AIRCRAFT TRACE	Creates shapes using the flight path of the aircraft. Points are placed every second while the aircraft is in motion.
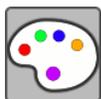
	CAMERA TRACE	Creates shapes using the camera. Points are placed every second while the camera is in motion.
	LAYER MERGE	Merges two overlapping shapes in the same layer combining them into one.

Shape Creation Tools

	SHAPE	Creates polygon shapes. The points of the polygon are connected creating a perimeter. Creating shapes displays information about that shape in the bottom left corner of the ARS screen including:

- Total number of points
- Calculated area
- Segment length
- Perimeter distance
- Crowd Density

	LINE	Draws lines on-screen by touching the desired points. Points are connected competing a line. Creating lines displays information about the line in the bottom left corner including:

- Total number of points
- Segment length
- Perimeter distance

	POINT	Places a single point or draws a series of points.

	FREE	Draws a free shape or line by dragging your finger or the cursor along the screen. Creating shapes with *Free* displays information about that shape in the bottom left corner including:

- Total number of points
- Segment length
- Perimeter distance

TIP

Using **NAME** and **POINT** simultaneously is the simplest method of creating dynamic layers consisting of multiple named points. Using this combination causes the **NAME** dialog to pop up after dropping a point allowing operators to name points on the go.

Search Pattern Creation Tools

	PATTERN	Creates and displays several types of search patterns on-screen. For full functionality see the corresponding Search Pattern section.
	UNDO	Deletes the most recent point if the operator makes a mistake.
	CANCEL	Cancels layer creation and changes to *Save Layer* after starting a shape.
	SAVE LAYER	Finalizes and saves layers and shapes.

Creating New Features Inside an Existing Layer:

1) Select the **SHAPE** button, and the type of layer to draw (*Shape, Line, Point, Free, or Trace*).
2) Select the **NEW** button to start the new feature.
3) Touch the screen, use the cursor, trace, or press the **X** key to place the points for the layer.
4) Search can also add points to your point, shape, or line.
5) Press **SAVE LAYER** when the layer is complete.

Editing and Saving Layers:

Once the layer is complete, select the layer from the Dynamic Layers Menu. By default, Dynamic Layers are titled *Layer_yyyy-mm-dd-time*.

Selecting the layer name allows operators to adjust the following settings: S*how, Hide, Save, Follow with the Aircraft, Follow with the Camera, Center On, Rename, Edit, Delete, Lock*, and more.

Keyboard users can press **CTRL+L** to edit the most recently created layer.

Importing layers from third party products:

ARS supports and displays custom icons exported to *KMZ* files. However, icons created in products like Google Earth and Google Maps are not displayed in ARS because they are not exported with the *KMZ* file in an ARS-usable format.

Crowd Density Estimation

Using the dynamic layer tool, ARS can map an area in real time to reveal the perimeter, area, and estimated crowd size. Crowd size estimation is achieved by taking the area measured and multiplying it by several crowd density estimates based on the published work of Dr. G. Keith Still. These numbers can be customized depending on the typical crowd densities encountered and by default are set to 0.85, 1.25, 2.0, and 3.5 people *per square meter*, respectively.

The crowd density estimation numbers are displayed in ARS left to right from lowest to highest density. The default lowest number has been calibrated to estimate a walking or marching crowd similar to what is shown the picture below.
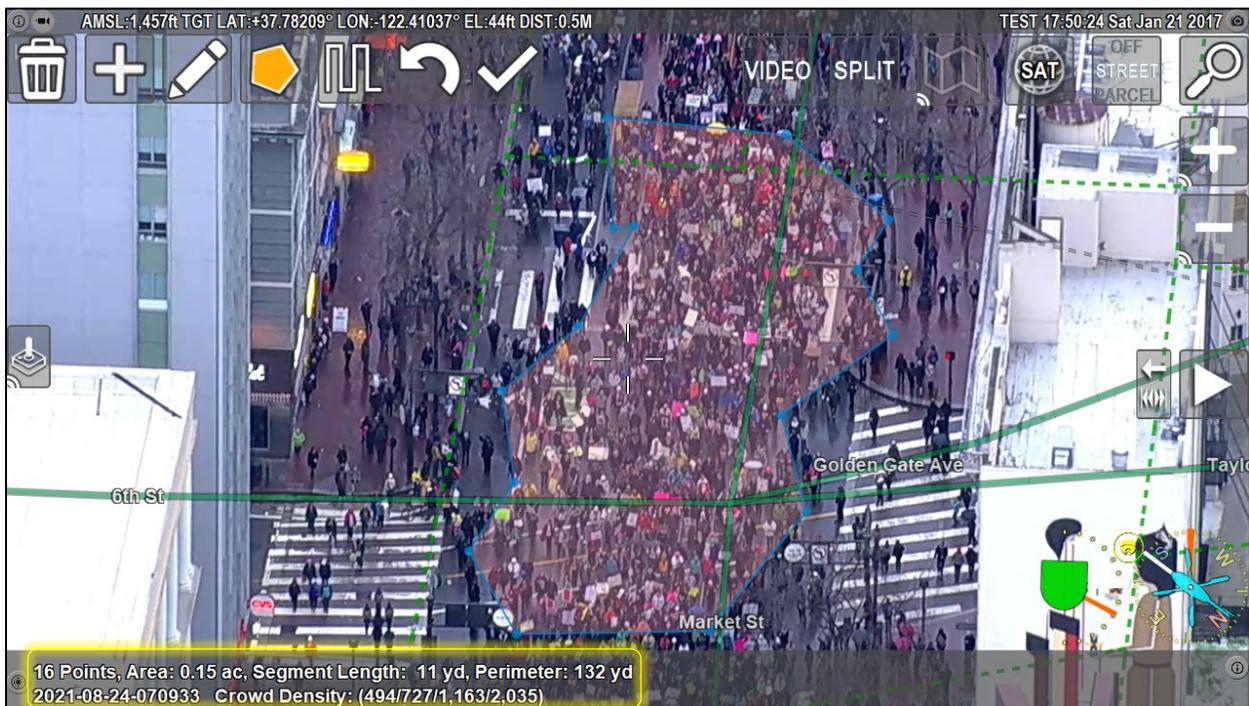
Crowd Density estimation performed in ARS on a marching crowd.

In the image above, the operator has created a dynamic layer with a perimeter of 132yd and an area of roughly 0.15 acres. Combining this with an estimated 0.85 people per square meter, the crowd count is estimated to be 494 at the low end. Using values for 3.5 people per square meter, the estimate is 2,035 at the high end. Through observational counting, it's clear the actual number is closer to the low end with this type of crowd. Note also how the operator has circled the main mass of people congregating, vs the entire street. Since crowds tend to form these aggregated masses, it may be necessary to create multiple shapes to more accurately reflect the count.

> **TIP**
>
> Crowd densities tend to appear larger than they actually are due to the slant angle involved during airborne observation. The same crowd viewed from a significant slant angle, compared to a crowd viewed from a top-down perspective, will generally be estimated larger than it should be. Take your slant angle into account when determining which values to report on the crowd size.

The picture below shows a much larger crowd. The operator has cutout various sections of the shape to account for streets, buildings, and other obstructions. Because the crowd has stopped moving, their density will trend upwards from the previous example. In this example, the crowd count is estimated to be between 25,082 and 103,280 people and due to the crowd configuration will most likely be on the higher end of the estimate.

With larger crowds, the operator can create multiple shapes to better estimate the overall size of the crowd.

In the above example, there are many groups of people congregating in areas not included in the large, center shape (area 1). Additional shapes can be added to account for these groups. Using the camera, the operator can zoom in to the smaller masses to capture their location to more accurately while existing shapes are maintained. An example of this is shown in the lower left of the screen (area 2). The crowd density estimate shown in ARS includes both shapes in aggregate, while the perimeter and area encompass only the selected shape.

Shapes used to create crowd density estimates can also be stored for later review in a standard KML or SHP file format. If the recorded video is loaded onto an ARS ground station, crowd density estimation layer tools are also available in playback.

Selecting a polygon's *Layer Info* option displays a crowd density and size estimation as well.
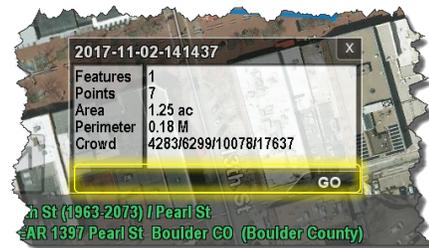
Search Patterns

Create and display search patterns in ARS to facilitate Search and Rescue scenarios. Operators can design several types of search patterns and display them on-screen.

Create patterns by entering the necessary information in the on-screen dialog box or draw the pattern out by selecting points with the touchscreen.

To edit existing search patterns, select the pattern from the Dynamic Layers Menu. Recall that Dynamic Layers follow the *Layer_yyyy-mm-dd-time* naming convention by default. Select the desired layer to *Display*, *Hide*, *Save*, *Aircraft Follow*, *Camera Follow*, *Center*, *Rename*, *Edit*, *Delete*, or *Lock* the pattern.

ARS can automatically follow lines and search patterns with the camera. Operators can also adjust the camera speed, and completed legs of the pattern display in red.

Formatting options such as selecting colors and editing names are also available through the Menu.

Show Pilot Waypoints on-screen designating the direction and distance from the aircraft to the pattern.

Note: Search Patterns are *temporary* and *deleted* on system shutdown unless saved.

Several Types of Search Patterns can be created and displayed on-screen:

 Creeping Line Search

 Expanding Square Search

 Sector Search

 Expanding Creeping Line Search

 Radius Circle

Creating Search Patterns

Create Search Patterns by entering the pattern information in the on-screen dialog box or manually draw patterns on-screen using the touch screen by selecting the points to be used in the pattern.

To create and display a Search Pattern:

1) Select the **Menu** button.

2) From the Menu, select **Dynamic Layers,** and **Create New Layer**.

3) Select the **PATTERN** button to enter a search pattern.

4) Enter the pattern information.

5) Select **Create.**

6) **Clear** clears the on-screen dialog box to start over.
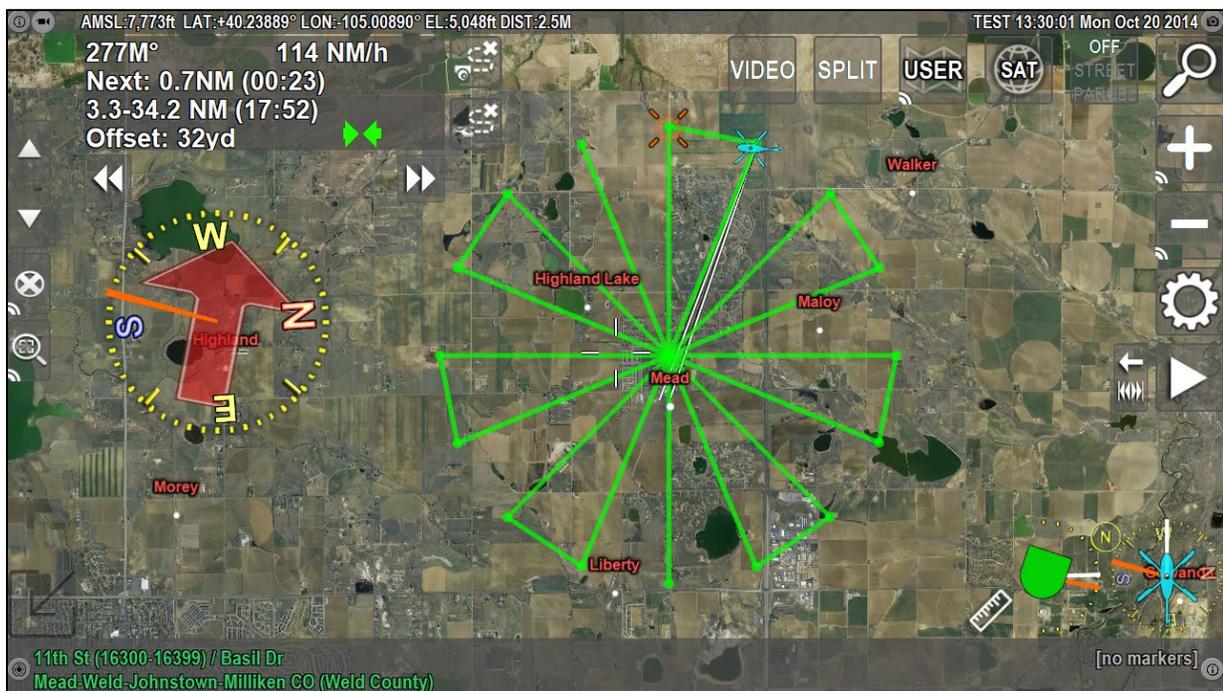
Sector Search Pattern drawn in ARS

Creeping Line Search
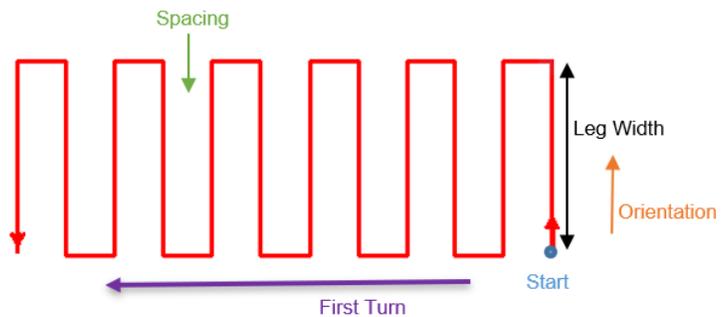
Start: Select the point where you would like the pattern to begin. Enter the start location by:

- Typing a latitude and longitude into the *Start* field.

- Clicking a start point on-screen.

- Clicking the **Find** button and entering a location.

Orientation: Enter the orientation of the pattern in degrees (1-360°).

Leg Width: Enter the width of the legs of the pattern.

Spacing: Enter the track spacing.

First Turn: Enter left or right to determine the pattern's first turn.

Legs: Enter the number of legs in the pattern, *or...*

Distance/Exit: Enter the pattern's total distance or the exit distance.

Clear Clear the entry and start again.

Create Creates and displays the on-screen pattern. The start and finish point's latitudes and longitudes are displayed in the dialog box, and the pattern is displayed on screen.

Manually Drawing Creeping Line Search:

1) Select the start point by clicking on the screen with the touch screen or cursor.

2) Enter the orientation and leg width by selecting a second point on the screen.

3) Enter the spacing and first turn direction by entering a third point on the screen.

4) Distance/Exit is calculated by clicking on the end point of the pattern.

5) Select **Create** and **Save Layer** to display and save the pattern.

Expanding Square Search
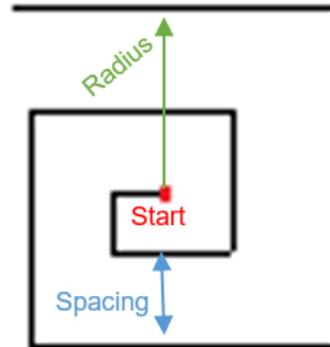
Start: Select the point where you would like the pattern to begin. Enter the start location by:

- Typing a latitude and longitude into the *Start* field.

- Clicking a start point on-screen.

- Clicking the **Find** button and entering a location.

Orientation: Enter the Orientation in degrees (1-360°).

Spacing: Enter the leg Spacing.

First Turn: Enter left or right to determine the pattern's first turn.

Legs: Enter the number of legs in the pattern, *or…*

Radius: Enter the pattern's radius.

Clear Clear the entry and start again.

Create Creates and displays the on-screen pattern. The start and finish point's latitudes and longitudes are displayed in the dialog box, and the pattern is displayed on screen.

Manually Drawing Expanding Square Search:

1) Place the start point by clicking on the screen with the touch screen or cursor.

2) Place the second point to determine the pattern orientation and spacing.

3) Place the third point to determine the pattern radius and first turn. Place additional points as necessary or enter the number of legs to further expand the Expanding Square Search pattern.

4) Select **Create** and **Save Layer** to display and save the pattern.

Sector Search
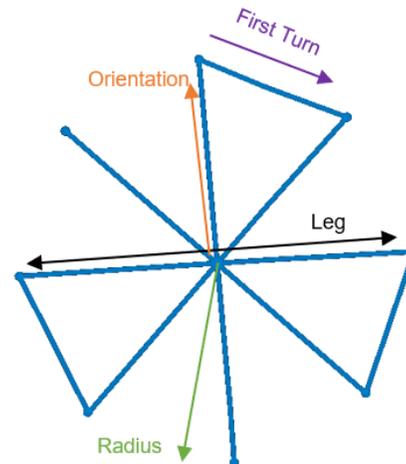
Center: Select the pattern's center point by:

- Typing a latitude and longitude into the *Center* field.

- Clicking a center point on-screen

- Clicking the **Find** button ⊚ and entering a location.

Orientation: Enter the orientation in degrees (1-360°).

Radius: Enter the pattern's radius.

First Turn: Enter left or right to determine the pattern's first turn.

Legs: Enter the number of Legs in the pattern.

Clear   Clear the entry and start again.

Create   Creates and displays the on-screen pattern. The start and finish point's latitudes and longitudes are displayed in the dialog box, and the pattern is displayed on screen.

Manually Drawing Sector Search

1) Select the center point by clicking on the screen with the touch screen or cursor.

2) Select the second point, which determines the pattern's orientation and radius.

3) Enter a third point, which determine the first turn direction.

4) Select **Create** and **Save Layer** to display and save the pattern.

✔ **Note:** Sector Search defaults to four segments unless otherwise specified in the dialog box.

Expanding Ladder/Creeping Line Search
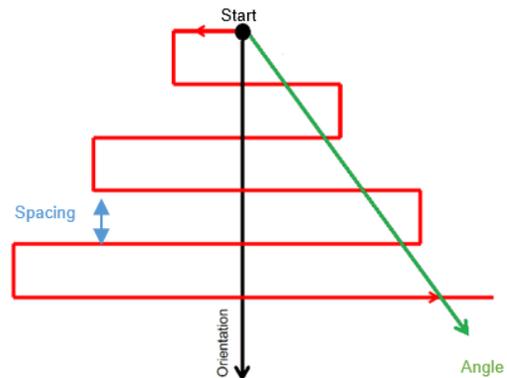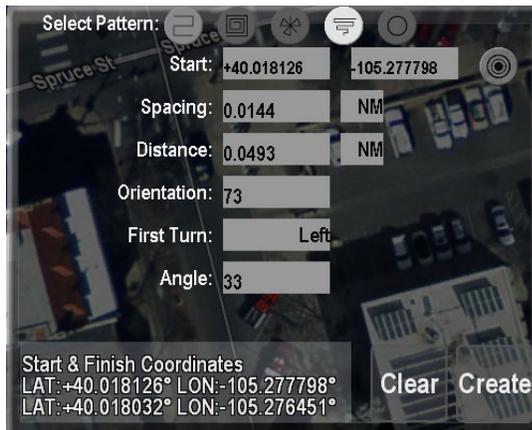
Start: To create the pattern, enter the start point by:

- Typing a latitude and longitude into the *Start* field.
- Clicking a point on-screen
- Clicking the **Find** button [⊚] and entering a location.

Spacing: Enter the leg spacing.

Distance: Enter the pattern distance.

Orientation: Enter the orientation in degrees (1-360°).

First Turn: Enter left or right to determine the pattern's first turn.
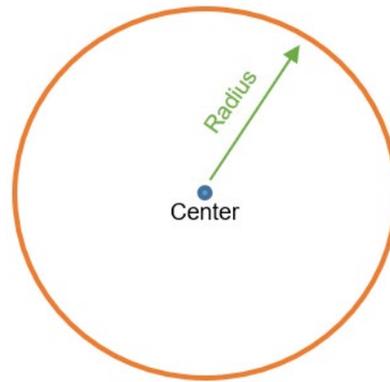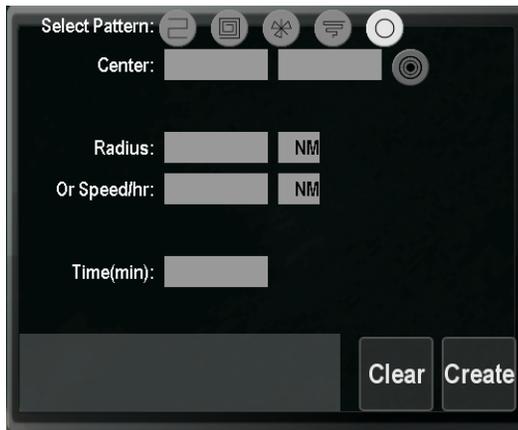
Angle: Enter the angle in degrees (1-360°).

Clear Clear the entry and start again.

Create Creates and displays the on-screen pattern. The start and finish point's latitudes and longitudes are displayed in the dialog box, and the pattern is displayed on screen.

Manually Drawing Expanding Ladder Search:

1) Select the start point by clicking on the screen.
2) Select the second point which will enter the Spacing of the pattern.
3) Enter a third point to determine Distance, Orientation, and First Turn.
4) Enter the end point to define the angle and calculate the distance.
5) Select **Create** and **Save Layer** to display and save the pattern.

Radius from Center Point

Center: Select the pattern's center point by:

- Typing a latitude and longitude into the *Center* field.

- Clicking a center point on-screen.

- Clicking the **Find** button ⊚ and entering a location.

Radius: Enter pattern's radius, *or…*

Speed/Hr: Creates a circle based on the allotted speed and time from the center point.
(Enter in speed per hour)

Time: Creates a circle based on the entered amount of time (in minutes) and speed per hour.
Draws the radius/circle based on the possible travel distance from the center point.

Clear   Clear the entry and start again.

Create   Creates and displays the on-screen pattern. The start and finish point's latitudes and
longitudes are displayed in the dialog box, and the pattern is displayed on screen.

Manually Drawing Radius from Center Point:

1) Select the center point by clicking on the screen.

2) Select a second point, which determines the outside radius required for the circle.

3) Select **Create** and **Save Layer** to display and save the pattern.

Vehicle and Camera Follow Modes

ARS features two follow modes that can be used simultaneously with dynamic layers to automatically steer the camera along a line, around a polygon layer, through a search pattern, or provide crews with necessary information when flying the aircraft (vehicle) along and around layer shapes.

TIP Operators can create or load features within a dynamic layer to enable follow-modes. Features can be lines, polygons, or search patterns. After creating the feature, use the waypoint display or Dynamic Layers menu to activate the desired follow mode.

Follow Modes Via Waypoint Displays

From the menu, turn on **Toggle Waypoint Display** (**W**) to show the on-screen waypoint display.

The two buttons on the right side of the waypoint display allow quick access to both follow-modes: **Camera Follow** (top right) *or* **Vehicle Follow** (bottom right).
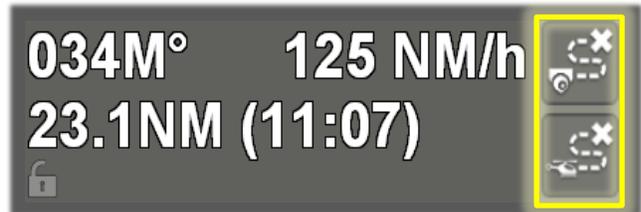
Keyboard users can select layers in the Dynamic Layers Menu and choose *Camera* or *Vehicle* Follow.

A Course Deviation Indicator (CDI) also displays in the bottom right of the Waypoint Display after entering either *Camera* or *Vehicle Follow* Mode. Observe the CDI indicator pictured below:

Note the Course Deviation Indicator in the bottom right of the Waypoint Display. The CDI changes from Green, to Yellow, to Red based on the Vehicle or Camera's offset relative to the Dynamic Layer's position.
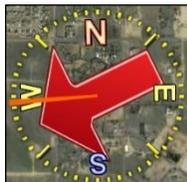
When used with the waypoint display, the compass shows the aircraft heading in an easily readable manner.

The red arrow points to the direction of the initial or entry point. The orange line or cone shows where the camera is looking.
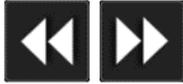
Camera Follow Mode

With camera follow mode, the camera automatically follows the feature (line, polygon, or search pattern). The on-screen buttons in the waypoint display give quick access to changing the camera start point, direction, and speed. Camera movement can be sped-up, slowed down, paused, and resumed.

Start *Camera Follow* by clicking the camera follow button. The **Rabbit** button increases movement speed along features while the **Turtle** button decreases movement speed along features.

Camera Follow Buttons

Camera Follow automatically follows the feature with the camera

Arrows designate the current point on the feature.

Reverse Direction switches movement direction along the feature.

Pause pauses camera follow mode. Re-selecting the pause button directs the camera to pick up at the location the camera was stopped and continues following the feature.

Rabbit increases camera speed along the feature.

Turtle decreases camera speed along the feature.

Note: Long pressing the **Rabbit** and **Turtle** buttons increases or decreases the camera speed along the feature allowing operators to adjust movement speed without repeatedly tapping on the screen.

Camera Follow Data Display:

Finish   The distance to the last point in the pattern.

Offset   Displays the offset of the aircraft.

Progress   Progression status along the feature, displays current point out of total points.

AGL   The altitude above ground level (AGL) of the aircraft.

ETA   Estimated Time of arrival.

CDI   Displays an arrow in the bottom right of the Waypoint Display showing the camera's deviation relative to the feature. The CDI changes from Green, to Yellow, to Red as the camera's offset relative to the feature increases, the length of the arrow also increases (*pictured on the bottom of the next page*).
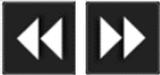
Vehicle Follow Mode

ARS directs the crew toward an entry point and then along the line, polygon, or search pattern when enabling Vehicle Follow mode. The waypoint display gives quick access to directional information.

Vehicle Follow Buttons

Aircraft Follow displays directions for following features with the aircraft.

Arrows designate the current point on the feature.

Vehicle Follow Data Display

Heading	The direction in degrees to the next feature point.
Next	Distance to the next feature point.
Finish	Distance to the feature's endpoint.
Offset	Current aircraft offset from the feature.
Progress	Progression status along the feature, displays current point out of total points.
ETA	Estimated Time of Arrival to the next point.
ETC	Estimated Time to Completion of the entire feature.
CDI	Displays an arrow in the bottom right of the Waypoint Display showing the vehicle's deviation relative to the feature. The CDI changes from Green, to Yellow, to Red as the vehicle's offset relative to the feature increases, the length of the arrow also increases.

```
099M°            121 NM/h
Next: 0.6NM (00:16)
0.0-4.8 NM (02:25)
Offset: 0m
```
```
155M°            117 NM/h
Next: 1.4NM (00:43)
0.0-6.5 NM (03:20)
Offset: 250m
```
```
154M°            113 NM/h
Next: 1.7NM (00:53)
0.0-7.1 NM (03:45)
Offset: 500m
```

Note the Course Deviation Indicator in the bottom right of the Waypoint Display. The CDI changes from Green, to Yellow, to Red based on the Vehicle or Camera's offset relative to the feature's position.

Direction Finding Modes (LoJack/RhoTheta)

When integrated with a direction-finding system (DFS) such as LoJack or RhoTheta, ARS display information about the signal strength and direction from the aircraft.

Through the Dynamic Layers Menu, operators can choose either to show the DFS information in the augmented reality video mode, the top-down map mode, or both.

Select the *Show Info* menu option the *Dynamic Layers* menu to display the DFS information box, as shown below.
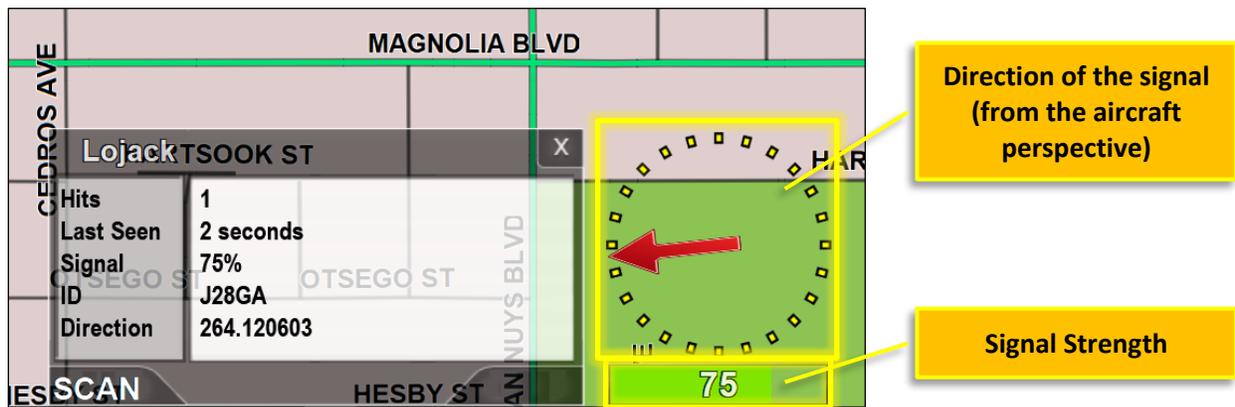

In the example above, the ID J28GA was last received 2 seconds ago and is to the left (9 o'clock) position, reference the aircraft. The signal strength is shown as 75%.

The red arrow showing signal direction is always referenced to the aircraft orientation, independent of any compass orientation setting used in the top-down map modes.

Scan vs. Lock

When multiple signal "hits" exist, the Mode indicated in the DFS information box can be used to show system operation. In Scan Mode, the ID with the highest signal strength is displayed. To lock onto a signal and track it exclusively, press the *Lock* button. Use the Next button to switch between IDs.

Scanning Mode

Locked Mode
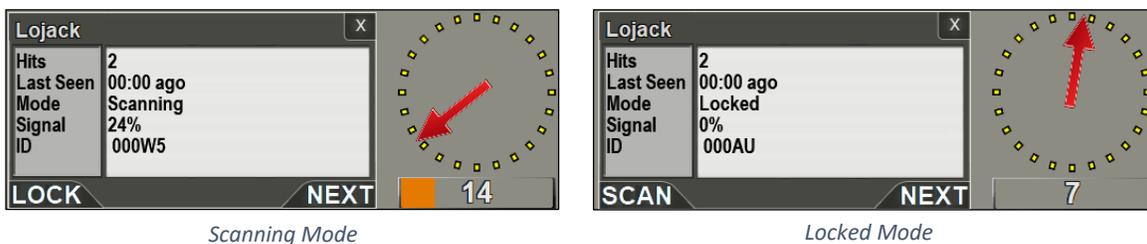
Closing DFS

Select *Hide* in the *Dynamic Layers*, [*DFS Type*], *Show/Hide* menu stop showing DFS information on the map and/or augmented reality display. To stop receiving DFS signals altogether for the rest of the session, select *Disable* in the *Dynamic Layers*, [*DFS Type*] menu.

Downlink Control Menu
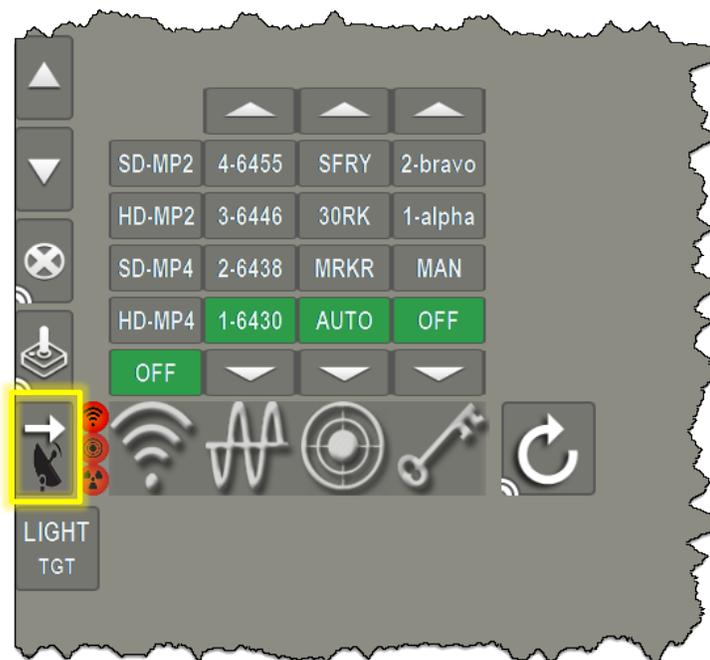
On-screen downlink controls within ARS.

ARS can be configured to include an on-screen interface and control menu for managing downlinks. The interface communicates with the downlink allowing touch-screen control of the downlink's basic functionality.

Options include *Transmission, Signal Output, Frequency Selection, Antenna Receive Site Selection, Encryption Keys*, and *System Reboot*. Operators can also display *Transmission Status, Inertial Navigation System Status*, and *Radiation Sensor Status*.

ARS interfaces with a multitude of transmitters and some features are unavailable for specific integrations and downlink models. The user interface and control menu may vary based on system integration. Contact SHOTOVER Systems for details.

Accessing the Downlink Menu

 Selecting the on-screen downlink icon displays the downlink menu.

 Select the downlink icon again to close the menu.

On-screen Downlink Menu

The on-screen menu allows communication control over the downlink system. After selecting an option, the system communicates with the downlink, and once the downlink confirms the selection, the selected option displays in red. This process may take a few seconds.

Note: Downlink menus vary depending on the downlink model integrated with ARS or other customizations. Not all options may be available to all operators.

Downlink Status Display

The Downlink Control Menu displays the downlink transmission, inertial navigation (Troll system INS), and radiation sensor statuses next to the on-screen downlink button. Status icons are displayed in green when signals are active or transmitting and displayed in red when inactive or experiencing issues.

The transmission icon changes green when downlink signals are active and transmitting. The icon changes red when the downlink signals are inactive or not transmitting.

The receive site icon changes green when the downlink's Inertial Navigation System (INS) is active and communicating. This icon changes red if the downlink INS is uninitialized or not communicating with ARS.

The radiation sensor icon changes green when the RAD sensor is active and transmitting. This icon changes red when the RAD sensor is off or not transmitting.

Output Transmission Signal

Select ON to turn on the output transmission signal or select the video type to send via the downlink. For example:

OFF	Turns off the downlink transmission.
SD-MP2	Outputs Standard Definition Video (MPEG-2)
HD-MP2	Outputs High-Definition Video (MPEG-2)
SD-MP4	Outputs Standard Definition Video (MPEG-4)
HD-MP4	Outputs High-Definition Video (MPEG-4)

Frequencies 〰️

Select frequency presets for downlink transmission signals. Use the **Up** and **Down Arrow** keys navigate available frequencies.
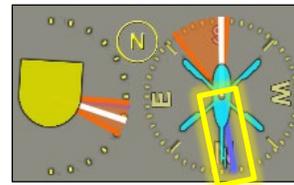
Antenna Receive Site or Broadcast Power ◎

Select the Antenna Receive Site or Broadcast Power for downlink transmissions. Use the **Up** and **Down Arrow** keys to navigate the list of available options and preprogrammed receive sites.

Antenna Receive Site

MRKR	Slews the antenna to a designated location for transmitting to mobile ground crews or downlinking to a non-programed receive site. Enter markers through ARS by touching the on-screen location or enter the location through the **Find** feature (address, latitude longitude, business name).
AUTO	Activates the auto function through the downlink unit. AUTO slews the antenna to the closest receive site programmed through the downlink.
CUSTOM	Custom receive sites can be added to the downlink menu. Contact SHOTOVER for more information.

The downlink antenna position can be shown in the Map Orientation icon (aircraft icon) typically located in the lower right of the ARS on-screen display. Here, a purple/blue line indicates where the downlink antenna is pointed.

Broadcast Power:

HIGH	Sets the transmitter broadcast power to High.
LOW	Sets the transmitter broadcast power to Low.

Encryption 🗝️

Select the encryption key for encrypting the downlink transmission signal. Use the **Up** and **Down Arrow** keys to navigate the list of available encryption options.

MAN	Selects the manual encryption setting.
OFF	Turns encryption off.

Video Input Switching

An optional video switch is incorporated when interfacing with some downlink systems to facilitate video input switching between two video sources. Use video input switching to downlink and switch between RAW camera videos and ARS overlay videos.

Reboot

A reboot button is incorporated in downlink control interface. Press and hold for at least one second to reboot the downlink when necessary.

Email

Email allows operators to send screenshots and active markers via the aircraft's onboard internet. Pressing the **Email** button opens an on-screen dialog box for emailing designated recipients. Contact SHOTOVER Systems Support for more information when enabling the Email feature.

Prerequisites:
1) Onboard LTE or Satellite aircraft internet with verified connectivity.
2) Email, login credentials, and outgoing SMTP server information.

Interface:

Click on the **Email** button in the lower left of the ARS screen to access the email composer. Clicking the **Email** button opens the composer while capturing a screenshot.

Cycle through address book contacts (**ALT+C**) or manually enter email addresses in the window's *To:* field. Add contacts to ARS via *Menu/User Preferences/Email Settings/Address Book/Create Contact*.

Edit the subject line as desired. Pressing **Shift + Backspace** clears all fields.
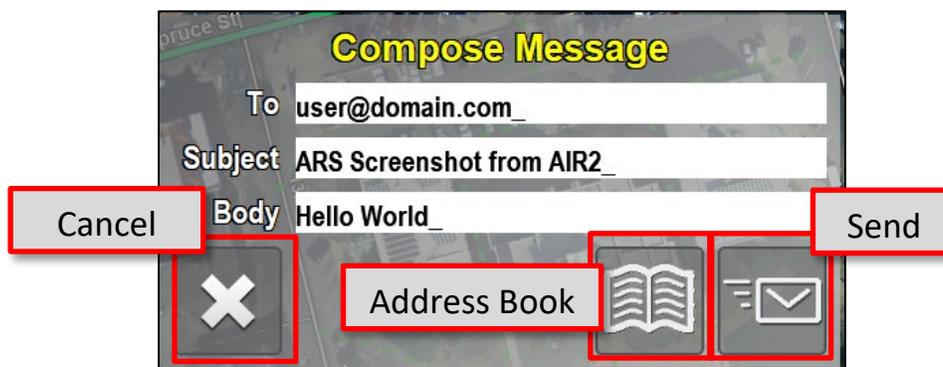
Email Composer window

Send emails by pressing the **Send** button (**Enter**). Once pressed, a confirmation dialog box appears in the lower-left corner informing operators if sending was successful.

Recipients receive a screenshot and its meta-data, depending on the configuration. Recipients can also determine the screenshot's exact location using the screenshot's associated KML, SHP, or GPX file.

Picture in Picture (PIP)

PIP simultaneously displaying the camera target and hoist camera.

ARS can simultaneously display two video inputs in a Picture in Picture (PIP) format. The PIP selection button turns PIP *on*, *off*, or *swap video inputs*. Operators can also adjust the PIP location by navigating to *Menu/User Preferences/PIP Location* and select PIP's location.

PIP displays the <u>first two</u> connected video inputs connected to ARS.

Displaying PIP

Pressing **Screen** displays the picture-in-picture view (**ALT+P**).
Pressing **Screen** again toggles full screen, turning off PIP mode.

Pressing **Swap** swaps the displayed videos in PIP (**ALT+I**).
Pressing **Swap** a second time swaps video inputs back to their original configuration.

Selecting PIP Location

From Menu:

1) Select *User Preferences*.
2) Select *PIP Location*.
3) Select the desired location; *Custom*, *Lower Left*, *Upper Left*, *Upper Right*, or *Lower Right*.

Note: Custom locations can be configured by SHOTOVER Systems Support.

Searchlight Steering

ARS can automatically direct searchlights via one of three steering modes: target, locked-onto a marker, or a pre-determined diversionary offset from the camera target. Press the on-screen **LIGHT** button to toggle between modes: *TGT* (target), *MKR* (marker), or *OFFSET* (offset).

The lower right corner icon set display the searchlight's position by showing a white triangle to denote the searchlight's elevation and azimuth.
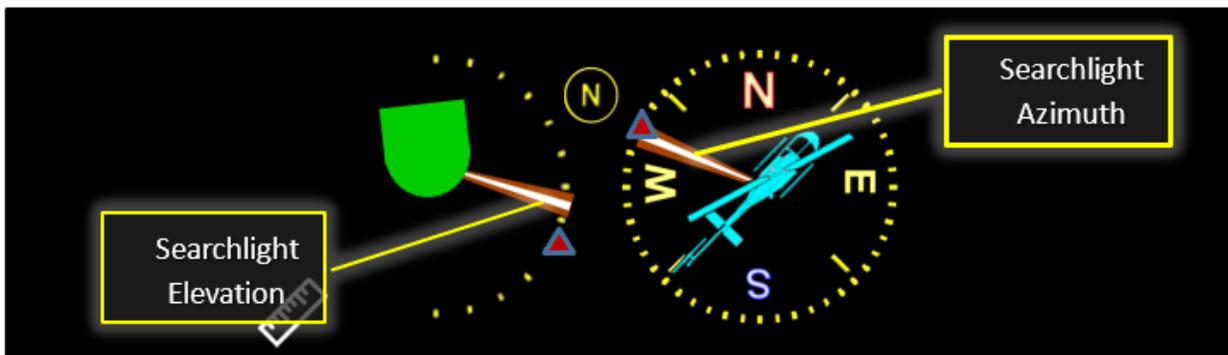
Searchlight Steering operating in TGT-mode. Note the camera and searchlight share the same position.

Searchlight steering is an always active protocol. Therefore, the selected ARS steering mode will command the searchlight only after the searchlight is placed into a compatible salving mode via the hand-controller, cyclic control, or other control head. With certain searchlights, operators may continue making fine, manual adjustments via the searchlight controls even while operating in ARS steering mode.

Note: ARS must be receiving INS position information before searchlight steering will reliably work.

Note: ARS enforces the searchlight's lockout areas even when operating in ARS steering mode.

Note: If the aircraft position causes the searchlight to pass through one of its lockout areas, the searchlight's position may move to avoid the lockout area. The searchlight returns to the ARS directed location once the lockout area is no longer a factor.

Note: When operators no longer want ARS to command the searchlight, exit slave mode on the searchlight using the searchlight hand controller, cyclic controls, or control head.
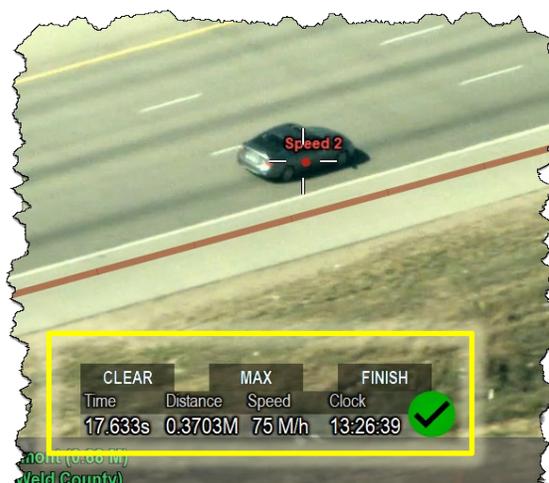
Speed Measurement

ARS's speed measurement feature allows operators to accurately measure ground-based vehicle speeds.

ARS measures time and distance-traveled between placed vehicle-markers calculating and displaying the vehicle speed on-screen in real-time.

Prerequisites

Operators must meet the following conditions before using ARS's airborne speed measurement feature to ensure speed measurement accuracy:

1) **Setup VASCAR Minimum Distance**
   VASCAR Minimum Distance allows operators to define the minimum distance (meters) the tracked vehicle must travel for valid speed measurements in ARS.

   SHOTOVER Systems recommends a minimum of 0.25 miles (402 meters) to attain at least 95% certainty in speed measurement results. Distances greater than 0.25 miles are also permissible.

   Access the VASCAR Minimum Distance setting in the Initial Setup Menu, and once set, operators no longer need to adjust this setting.

2) **Perform Gimbal INS or Deviation Calibration Every 24 Months *and* After Maintenance**
   INS calibration (external IMU/INS gimbals) or Deviation Calibration (internal IMU/INS gimbals) should be performed under the following schedule:

   a) Following the initial installation of the ARS unit.

   b) After ARS maintenance that involves removal of the unit from the aircraft.

   c) After ARS software updates or hardware updates/replacement.

   d) Following any gimbal maintenance, upgrades, or replacement.

   e) Every 24 calendar months.

   Depending on hardware, operators have menu options for either INS calibration <u>or</u> Deviation Calibration, but **not both**. Access calibration settings under the Initial Setup menu.

3) **Ensure no INS Errors are Present**
   ARS must have INS positional information to conduct speed measurements. Without it, speed and distance measurements are inaccurate or impossible.

   Operators should verify ARS is not displaying "Waiting on INS" or similar errors in the lower left of the ARS screen on every flight.

   If INS errors are present, power-cycling the camera may resolve the issue. If the error persists, fly several S-turns to assist the camera in locking the INS.

4) **Conduct a Pre- or Post-test**

SHOTOVER Systems recommends periodically conducting pre- or post-tests to ensure speed measurement validity. See the following pre- and post-test sections for recommended testing procedures.

Enabling Speed Measurement

There are three ways to enable speed measurement in ARS:

Touchscreen

1) Pressing the ![ruler icon] button located on the lower right of the screen once displays the speed measurement window.

Menu

1) Open the *Menu*.

2) Select *Measurement* from the list.

3) Select *Speed* as the measurement feature.

Keyboard

1) Pressing the **V** key displays the speed measurement window.

2) Pressing the **V** key two more times closes the speed measurement window.

Speed Measurement Interface

The speed measurement window appears in the lower center of the display after enabling speed measurement.

The window displays the time and distance traveled by the vehicle since the initial marker placement. ARS calculates and displays speed next to a clock for reference.

VASCAR Min Distance not met = red indicator

VASCAR Min Distance met = yellow indicator

The speed measurement indicator changes from red to yellow after tracked vehicles exceed the VASCAR minimum distance (usually 0.25 miles or 400m).

Once the indicator turns yellow, the speed measurement process has collected enough data to return speed with at least 95% certainty, often greater. Dropping a second marker will return the calculated in speed values as well as a green checkmark indicating validity of the measurement.

Using Speed Measurement

Operators must place a minimum of two markers to use the speed measurement tool. These markers are the _initial_ and _current_ markers. Produce accurate speed measurements via the following steps:

1) First, understand that the Speed Measurement Tool only works when measuring **linear** distance. So, if the tracked vehicle was to be travelling in circles or along a curve, results will be unusable.

2) Enable the speed measurement screen as described above (Press Ruler icon or **V** key once).

3) Place the first marker on the vehicle. Note the indicator remains **red (X)** because the vehicle has not traveled far enough for ARS to calculate a valid speed measurement.

4) When the indicator turns **yellow** (X) the VASCAR minimum distance parameter has been met and ARS now has enough data to return a speed with high confidence. Place the second marker on the vehicle to have ARS perform the speed measurement calculation.

5) Note the vehicle's speed and the indicator turns green (✔) showing that ARS has accurately calculated the _lowest average speed_ of the vehicle between the initial and current markers. This speed is the vehicle's _minimum_ travel speed**.**

6) An unlimited number of markers can be placed, but average vehicle speed is calculated based on time and travel distance _from the initial marker to the current marker_.
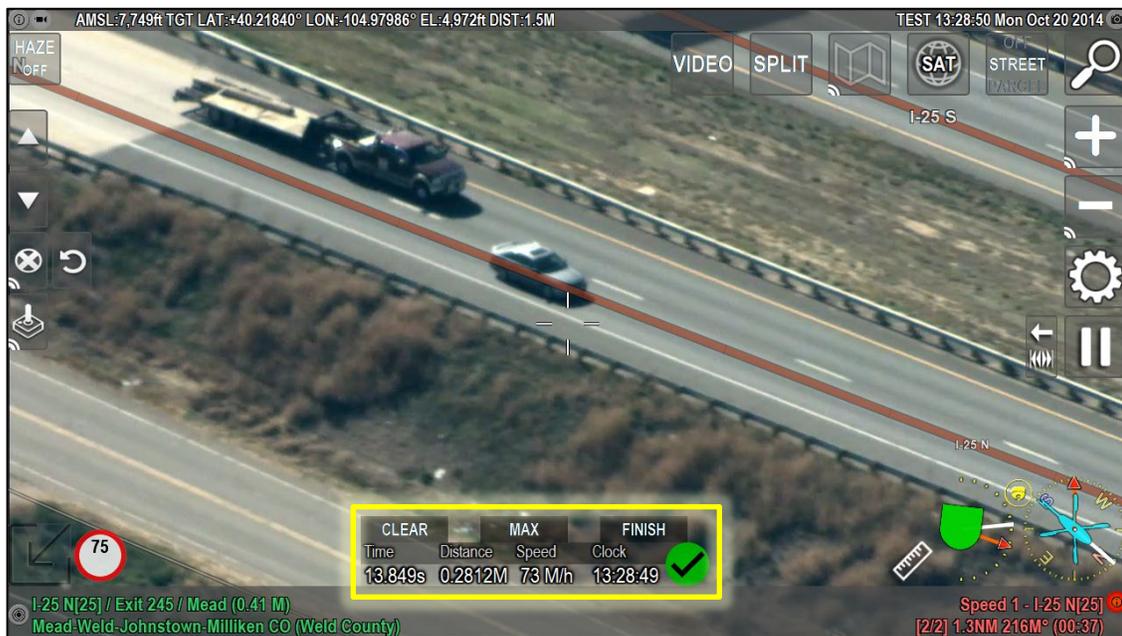
In this example, the vehicle was moving at least 73 mph over the measured distance (0.2812 miles) and time (13.849 sec).

💡 **TIP** Do not confuse reticle speed with speed measurement. Reticle speed is an immediate readout of how fast the camera's reticle is moving across the ground. Speed measurement is a more accurate process of precisely determining the speed of a vehicle.

Speed Between Markers

ARS always calculates average speed between the initial marker, labeled "Speed Start" and the current marker. Additional markers can be used during speed measurements for calculating average speed over longer distances. As each subsequent marker is placed, the speed measurement window will update to reflect the average speed for the selected distance and time. But remember that the initial marker is _always_ the starting point for speed calculations.

For example, when placing five markers during speed enforcement, ARS displays the speed calculation based on the distance travelled and time from the first marker ("Speed Start") to any of the subsequent four markers, whichever is active.

Menu

Using the ▲▼ buttons on the left side of the screen changes which marker is the current marker when determining average speed calculations.

Keyboard

Press the **P** key to select the previous marker and press the **N** key to select the next marker.

The **CLEAR** button resets the interface and allows operators to start over with another speed measurement. The _CLEAR_ button also deletes the associated VASCAR video file (if enabled). See more information about clearing speed measurements on the next page.

The **MAX** button allows the operator to review the maximum speed recorded during the speed measurement process.

The **FINISH** button resets the interface **and** saves a video clip of the measurement (if enabled in the _Main Menu/User Preferences/Recording/Auto Record/VASCAR_) **and** .CSV file detailing speed measurement calculations (if enabled in the _Main Menu/Initial Setup/VASCAR Comment Prompt_).

Operator Comments

If "_VASCAR Comment Prompt_" is enabled in the _Initial Setup Menu_, after the FINISH button is pressed, an on-screen keyboard will prompt the operator to optionally enter free-form information about the infraction. This could include the operator's initials, license plate number, vehicle description, etc. This information is saved to the removable drive in a .CSV file format for future reference.
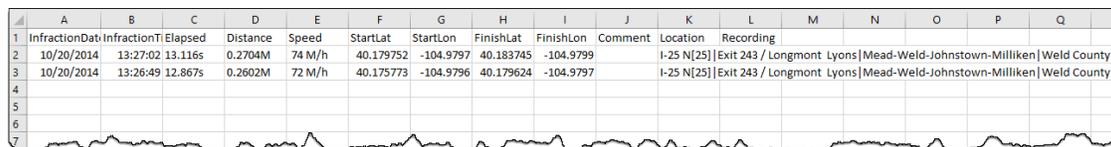
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	InfractionDat	InfractionT	Elapsed	Distance	Speed	StartLat	StartLon	FinishLat	FinishLon	Comment	Location	Recording					
2	10/20/2014	13:27:02	13.116s	0.2704M	74 M/h	40.179752	-104.9797	40.183745	-104.9799		I-25 N[25]	Exit 243 / Longmont Lyons|Mead-Weld-Johnstown-Milliken|Weld County					
3	10/20/2014	13:26:49	12.867s	0.2602M	72 M/h	40.175773	-104.9796	40.179624	-104.9797		I-25 N[25]	Exit 243 / Longmont Lyons|Mead-Weld-Johnstown-Milliken|Weld County					
4																	
5																	
6																	
7																	

The SpeedReport.CSV file when viewed in Microsoft Excel.

Clearing Speed Measurement

Operators must reset Speed Measurement by clearing the speed measurement results before performing new speed recordings for additional vehicles.

This section describes how to delete speed measurement markers without deleting other placed markers in ARS. Closing the speed measurement window does *NOT* clear the results.

Pressing **CLEAR** (**ALT+V**) in the upper left of the speed measurement window clears all associated speed measurement markers, along with the speed measurement window, and does *NOT* save the associated video file (if */User Preferences/Recording/Auto Record/VASCAR* is enabled).

> **TIP** The usual methods of clearing markers in ARS (**D**, **ALT+D**, **On-screen Delete Button**) deletes all ARS markers, not just speed measurement markers. Delete only speed measurement markers by using the **CLEAR** button (**ALT+V**) in the speed measurement window.

Accuracy of Speed Measurement

ARS reports minimum speeds with limited margin of error. Select a desired accuracy percentage via *Menu/Initial Setup/VASCAR Min Accuracy.* Use ARS Speed Measurement under the following conditions to consistently ensure this level of precision.

- Perform validation once *every* 24 months or sooner if conducting camera maintenance or updating ARS software. For more information, see the Speed Measurement Validation section detailed below.

- Conduct operations using road sections with the following characteristics to ensure accurate readings:
    - Continuous grade rather than inclines and declines.
    - Straight rather than curving roads.
    - Avoid bridges or overpasses less than the VASCAR minimum distance in length.

> ✔ **Note:** ARS performs speed calculations based on the following formulas:
>
> **Speed =** ((distance ÷ time) × 3600) calculates speed.
>
> **Distance =** ((speed ÷ 3600) × time) calculates distance.
>
> **Time =** ((distance ÷ speed) × 3600) calculates time.

Pre- and Post-test Procedures

Pre- and post-test processes ensure the accuracy of Speed Measurement by individually validating the time and distance measurement components of ARS, along with the calculated speed value.

Operators should periodically use these processes to confirm system accuracy of any speed enforcement activities. Operators can choose to perform time and distance measurement validation or validation against an external standard. Each process is detailed below:

Time Measurement Pre- and Post-test
ARS utilizes an internal system clock and timing device when confirming time measurement accuracy. Perform accuracy validation in-air or on-ground, SHOTOVER Systems recommends _on-ground_ testing for the sake of simplicity.

1) Open the speed measurement window in ARS.

2) Holding a timing device in one hand, simultaneously start the timer while pressing the on-screen button (**X**) with the other hand starting the ARS clock.

3) When the timing device reaches roughly 60 seconds, stop the timer, and simultaneously press the on-screen button (**X**) again stopping the ARS clock.

4) Since no vehicle is currently tracked, disregard the absent time, speed, and distance metrics. Operators only need to compare the times displayed on the timing device and the ARS speed measurement window.

ARS's Speed Measurement time should be within one second of the external standard

5) Timings should be accurate to within one second of one another. If not, re-test with both the keyboard and touchscreen (*if installed*). Contract SHOTOVER Systems if timing disparities continue and are greater than one second.

6) Once ARS calculates the error to be within the configured tolerance set by the *VASCAR Minimum Distance* setting (usually 0.25 miles or 400m), the X turns yellow to indicating ARS is ready for another marker as the final speed measurement.

Distance Measurement Pre- and Post-test

Operators must perform distance measurement accuracy validation in-air since distance measurement validation involves comparing ARS reported distances with pre-measured ground markers.

1) Open the speed measurement window in ARS.

2) Fly directly over the pre-measured area at a relatively low altitude with the camera pointed as straight down as possible, minimizing slant angle errors.

3) Position the camera centering the first pre-measured mark in the lens and place a marker.

4) Repeat for the second pre-measured mark.

5) Since no vehicle is currently tracked, disregard the speed and distance calculations. Operators only need to compare the distance displayed by the ARS speed measurement window and the known distance.
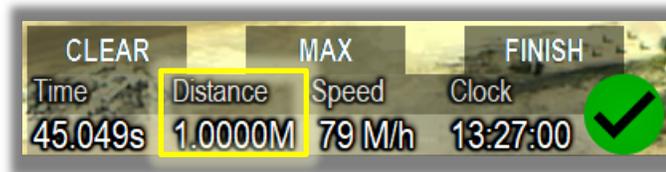
6) The measured distance vs. known distance should be within or better than the VASCAR Minimum Accuracy value set by the operator. If not, re-test ensuring exact marker placement on the pre-measured marks. Perform a gimbal calibration if distance disparities continuously exceed the VASCAR Minimum Accuracy percentage.

Validation Against an External Standard

The availability to perform speed measurement validation using external standards (like a patrol vehicle with a certified speedometer or radar) varies by operator.

External standards are acceptable means of ARS speed measurement process validation when available to operators. Perform this test in-air as it involves comparing the speed reported by ARS to the known vehicle speed per the external standard (patrol vehicle).

When validating, ensure the vehicle is traveling along a flat section of road free from bridges, overpasses, or changes in elevation.

1) Open the speed measurement window in ARS.

2) Place the initial marker on the patrol vehicle traveling at a known speed.

3) Place another marker on the patrol vehicle once the vehicle exceeds the VASCAR minimum distance criteria (0.25 miles by default).

4) Note the speed reported by ARS and compare it with the known speed of the external standard.
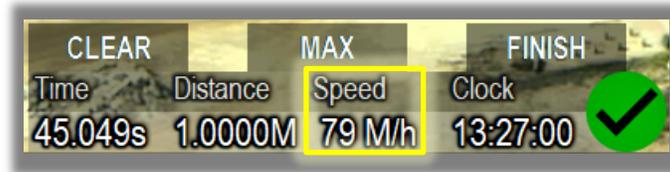
5) The measured speed vs. known speed of the external standard vehicle should be within or better than the VASCAR Minimum Accuracy value set by the operator. If not, re-test ensuring exact marker placement on the vehicle. Perform a gimbal calibration if speed disparities continuously exceed the VASCAR Minimum Accuracy percentage.

Distance Measurement

Distance Measurement in ARS is similar to the Speed Measurement in the previous section. Distance Measurement is part of the same tooling as Speed Measurement and accessed by pressing the button or **V key** twice.

Measure distances in any mode, Video, Map, or Split-Screen. Operators always see the distance between initial and current markers when using the distance measurement tool.

Enable Distance Measurement

There are three ways to enable distance measurement in ARS:

Touchscreen
1) Press the button located on the lower right of the screen _twice_ to display the distance measurement window.

Menu
1) Open the _Menu_**.**

2) Select _Measurement_ from the list.

3) Select _Distance_ as the measurement feature.

Keyboard
1) Pressing the **V** key twice displays the distance measurement window.

2) Close the distance measurement window by pressing **V** once more.

Distance Measurement Interface

Once distance measurement is enabled, the distance measurement window will appear in the lower center of the display. This window displays the distance and direction **from the previous marker to the current (active) marker**.

In this example, discarded evidence has been located 20 yards southwest of the vehicle marker.

TIP It is helpful to communicate in a *"from us to them"* or *"from good guys to bad guys"* format when directing units to placed markers. This ensures compass directions are relayed correctly referenced from the previous marker to the current marker.

Clearing Distance Measurement

ARS provided distance measurements are not cumulative. Each time operators place a marker, the distance and direction provided are from the previous marker to the current marker.

It is unnecessary to clear markers used in distance measurement when measuring new distances. Also, closing the distance measurement window does _not_ clear results.

Touchscreen

1) Pressing and holding the **Delete Markers** button clears all distance measurement markers.

Keyboard

1) Simultaneously press the **ALT + V** keys then release.

2) This deletes all distance-measurement markers and clears the distance measurement window.

TIP The usual methods of clearing markers in ARS (**D**, **ALT+D**, **touchscreen delete**) deletes all markers, not just distance measurement markers. Delete only distance measurement markers by pressing **CLEAR** (**ALT+V**) in the speed measurement window.

Watermark

Video recorded using ARS can be watermarked with a custom image or text. For example, an agency logo can be unobtrusively applied to either the recorded screen UI or the raw recorded video. Text showing the coordinates of the camera target and the date/time when the video was captured can also be embedded into the video. This is helpful for ensuring that video captured by an agency is marked to avoid misuse or to identify the origin and location of video evidence.

Graphical watermark shown on both the operator interface as well as the raw recorded video.

Pilot Display

Pilot Display is a free, iOS-compatible companion app to ARS developed to provide navigational and gimbal data to pilots via a mobile device.

The app communicates wirelessly with ARS and provides a pilot-centric display of information from ARS such as gimbal orientation, camera field of view, current aircraft position relative to the active marker, ETE and ETA to the active marker, slant distance information, and much more.

Display markers and dynamic follow layers via Pilot Display to provide pilots with the situational awareness necessary for quickly flying the aircraft to the defined location(s).

Pilot Display [Apple iPhone]

Compatibility

Pilot Display is compatible with any iOS device version 9.2 or higher. Contact SHOTOVER Systems Support if you are unsure of your device compatibility.

Requirements

Prior to using the Pilot Display app, you must have the following:

☐ **Wireless router connected to the ARS unit.**

☐ **Configuration to enable Pilot Display data and streaming video.**

☐ **Your iOS device <u>must</u> be connected to the same network as ARS.**

Note: iOS devices must connect to the network of the ARS connected router. Contact SHOTOVER Systems for router hardware recommendations and setup information.

Pilot Display Setup

Pilot Display uses a wireless router acting as an access point to wirelessly transmit video and position data from ARS to an iOS mobile device.

Once the Wi-Fi network is visible to the device Pilot Display is running on, complete the following steps:

Connection Steps

1) Go to the *Settings* menu.

2) Select *Wi-Fi*.

3) Connect your iOS device to the Wi-Fi network.

4) Confirm connection status by verifying that the Wi-Fi logo ( ) is present.

5) Open Pilot Display. You will see a series of connection messages as Pilot Display establishes a connection to the ARS host and then the app will open.

Please see the **Pilot Display Manual** for full setup details and usage tips.

System Calibration

> ⚠️ **Do not alter the Initial Setup configurations of ARS unless explicitly instructed by SHOTOVER Systems. Incorrect settings in this menu can adversely impact ARS software operation.**

Optical Center Calibration

The camera's optical center refers to the on-screen location where the camera zooms in and where lens distortions such as pincushions or barrel effects occur.

Cameras exhibit a perfect optical center with a precisely centered imaging chip behind the lens during manufacturing and the lens mounted in the plane is precisely parallel to the sensor. Perfect optical centers rarely occur because the sensing elements are tiny on the focal plane array (digital sensor).

This is a problem for mapping systems because while the gimbal indicates it is looking at the same position regardless of zoom, the gimbal is looking at two different locations. If there is an excessive error margin, consider contacting your gimbal manufacturer and request a camera replacement.

Manufacturers attempt to minimize these effects for gimbals with an internal IMU via camera selection and lens collimation procedures, but the effects may still be present.

Regardless, the internal IMU is bore-sighted with the camera at an unknown focal length, typically one extreme or another, or an average of both. Ultimately, there is no opportunity for ARS to improve matters in this regard.

Regardless of INS maintenance or camera removal, calibrating the optical center only needs to be completed once per camera. The lens's relationship to the sensor is unlikely to change, remaining constant for the camera's life unless changed by the manufacturer during servicing. Note: this is more likely to occur in cameras with tele-extender lenses.

For this reason, lower-end gimbals often lack accurate optical centers - but if present, the optical center is easily observed by following the steps below:

Checking for Good Optical Center Calibration:

1) Null the gyros if necessary, so there is no drift. Consult the gimbal manufacturer's manual for instructions on how to do this if you are unfamiliar with the procedure.

2) Choose and place an object in the crosshairs. If you notice you are zooming in on something else, the optical center is not the camera center.

Calibrating the Optical Center:

Perform optical center calibrations in-air or on-ground. SHOTOVER Systems recommends on-ground testing for simplicity's sake. Using the gimbal:

1) View a far object that remains in-focus when the gimbal is at maximum zoom.

2) Zoom-in to the maximum limit of the gimbal, making sure to null out the drift.

3) Enable ARS's *Camera Calibration* mode.

   Touchscreen
   1) Access the *Main Menu* with the on-screen menu button (**M**).

   2) Select *Initial Setup* from the list.

   3) Select *Calibrate Optical Center*.

   4) Select *Start* in the upper right corner.

   Keyboard
   Simultaneously press **CTRL+ALT+F9.**

4) Zoom back out to the widest setting.

6) Using the on-screen or keyboard arrow keys, position the crosshair back on the chosen object.

7) Verify the calibration by zooming in and out. The object should remain in the center of the screen. If it does not, repeat the procedure. You can also adjust the offset in either the maximum or minimum zoomed-in modes – the goal is to ensure a central target in the crosshairs at both zoom levels.

8) Exit *Camera Calibration* mode after a successful calibration.

INS Calibration

SHOTOVER Systems highly recommends INS Calibration for cameras with external IMUs, especially when the camera or IMU has recently been removed, reinstalled, or received any software updates.

Cameras with integrated IMUs only need to have their deviation calibrated for speed patrolling. Systems with integrated IMUs not using the speed feature can skip this section as they do not have INS calibration as a menu option.

IMPORTANT:

Always perform INS calibration in-air. Also, the location the pilot chooses to orbit, and the active marker or camera target, is essential. The orbit should not be too close to the marker and should not center on the marker but should instead center on a position offset from the marker.
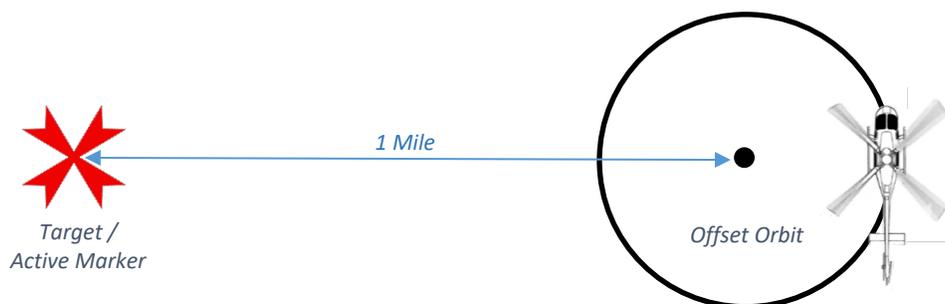
When performing offset orbits, the camera rotates a full 360°. ARS accurately determines the differences between the camera and IMU reports by collecting points along the camera's full rotation.

While Flying

1) Identify a feature that is visible in ARS in *Map-Mode* and easily located in the video. The location must be at ground level in a relatively flat area. Usually, a sports field works well. In the case of a statue, the operator should keep the crosshairs focused on the statue's base.

2) Place a marker at that location using the ARS's *Map-Mode*. This is your target.

3) Pilots should pick a separate reference point to fly around in an <u>OFFSET ORBIT</u>. Pilots should also center the orbit roughly 1 mile away, no less than 0.5 miles to the inner section marker, and no more than 3 miles to the outer section marker. Flying at higher altitudes is better due to more optimal slant angles. Use the narrowest possible field of view.

> ✓ ***IMPORTANT: Pilots should fly an offset orbit from the target, not centered on the selected target, but offset in any direction by roughly 1 mile.***

Target / Active Marker   1 Mile   Offset Orbit

4) Once the pilot has established a consistent turn rate, press **VIDEO** on ARS and find your target using the Hand Control Unit (HCU).

5) Enter INS calibration mode by selecting the *Menu/Initial Setup/Calibrate INS* menu option.

6) Select **START** in the upper right corner of the ARS screen. Keyboard users may press **CTRL+ALT+F6** in place of any button presses.

7) Select **NEXT** in the upper right corner of the ARS screen.

8) Keep the camera in a narrow zoom centered on the target for a full 360° orbit.

9) Select **NEXT** in the upper right corner of the ARS screen.

10) Tap the target on the screen, _making sure to click on the actual physical target in the video_, not the placed marker. This is known as *placing a point*.

11) Place at least 20 points, one every few seconds. Avoid placing points when the camera is rapidly shaking or moving.

12) Select **SAVE** in the upper right corner of the ARS screen and verify the new calibration.

Note:
Operators may see a **BAD INS ALIGN** message during ARS calibration. On the same screen underneath, note the set of numbers – Attitude Error and Position Error.

This error appears if the Attitude Error is greater than 0.15 degrees or the Position Error is greater than 10 meters. The above message often means that INS did not have enough time to align.

Before reattempting calibration, fly for 10-15 minutes with as much motion as possible with S-turns, sharp orbits, and frequent direction changes. This type of motion facilitates INS alignment.

If the message persists while reattempting calibration, take note of the position error and the attitude error and continue the process. The message does _NOT_ prevent operators from completing calibration.

Calibrate Deviation

Operators involved in airborne speed measurement with integrated IMUs should perform a deviation calibration every time the camera is removed, reinstalled, or has received any software updates. This ensures speed measurement processes are accounting for known positional accuracy camera errors.
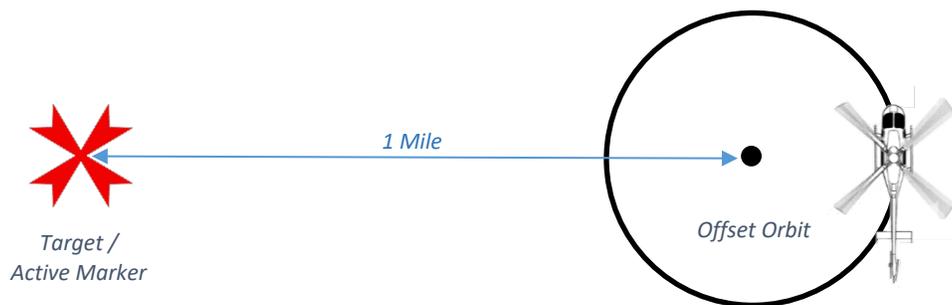
IMPORTANT:
Always perform deviation calibration in-air. Also, the location the pilot chooses to orbit, and the active marker or camera target, is essential. The orbit should not be too close to the marker and should not center on the marker but should instead center on a position offset from the marker.

While Flying
1) Identify a feature that is visible in ARS in *Map-Mode* and easily located in the video. The location must be at ground level in a relatively flat area. Usually, a sports field works well. In the case of a statue, the operator should keep the crosshairs focused on the statue's base.

2) Place a marker at that location using the ARS's *Map-Mode*. This is your target.

3) Pilots should pick a separate reference point to fly around in an _OFFSET ORBIT_. Pilots should also center the orbit roughly 1 mile away, no less than 0.5 miles to the inner section marker, and no more than 3 miles to the outer section marker. Flying at higher altitudes is better due to more optimal slant angles. Use the narrowest possible field of view.

> ✔ *IMPORTANT: Pilots should fly an offset orbit from the target, not centered on the selected target, but offset in any direction by roughly 1 mile.*

1 Mile

Target /
Active Marker

Offset Orbit

4) Once the pilot has established a consistent turn rate, press **VIDEO** on ARS and find your target using the Hand Control Unit (HCU).

5) Enter deviation calibration mode by selecting *Menu/Initial Setup/Calibrate Deviation*

6) Select **START** in the upper right corner of the ARS screen. Keyboard users may use **CTRL+ALT+F7** in place of any button presses.

7) Select **NEXT** in the upper right corner of the ARS screen.

8) Keep the camera in a narrow zoom centered on the target for a full 360° orbit.

9) Select **NEXT** in the upper right corner of the ARS screen.

10) Tap the target on the screen, _making sure to click on the actual physical target in the video_, not the placed marker. This is known as _placing a point_.

11) Place at least 20 points, one every few seconds. Avoid placing points when the camera is rapidly shaking or moving.

12) Select **SAVE** in the upper right corner of the ARS screen and verify the new calibration.

Calibrate Payload to Sensor

Operators using cameras with integrated IMUS should use the calibrate payload to sensor option to create a physical offset in the overlay position to account for the camera's positional errors. Only use this option when instructed by SHOTOVER Systems.

While Flying

1) Observe the current location of the overlays while using ARS's *Video-Mode*.

2) Flying an orbit is unnecessary for conducting a payload to sensor calibration.

3) Select *Menu/Initial Setup/Calibrate Payload to Sensor* to enter payload to sensor calibration mode.

4) Select **START** in the upper right corner of the ARS screen. Keyboard users may use **CTRL+ALT+F10** in place of any button presses.

5) Use the on-screen or keyboard arrows to reposition the overlay.

6) Press the **SAVE** button (**CTRL+ALT+F10**) once satisfied with the overlay positions.

Field of View (FOV) Calibration

Some cameras report different field of view (FOV) values than what is present in the video. ARS allows operators to correct for these variances in FOV.

The visual representation of a variance in FOV is determined by looking at and comparing two vertically-aligned ARS road overlays with actual roads shown in *Video Mode*. If the ARS overlays are farther apart or closer together than the actual roads in ARS *Video-Mode*, you may need to calibrate the FOV. Note that this calibration is for each sensor such as *daylight*, *low-light*, *IR*, and others.

IMPORTANT: System calibration is a factor of all calibration procedures: Optical center, INS, and FOV. Operators receive the most accurate results by repeating the INS and FOV calibration again after the initial passes of both.

✔ If an extender is present, the following steps should be performed with the extender and then again without the extender.

While Flying

1) Identify a feature that is visible in BOTH *Video-Mode* using the camera **and** *satellite Map-Mode* in ARS. The ideal location should be at ground level in a relatively flat, open area. Usually, features like tennis courts or outdoor basketball courts work well.

2) Pilots should fly a standard obit around the feature at an altitude that ensures the feature is fully visible when the camera is zoomed all the way in. If you reach maximum zoom in and the feature becomes cropped or obscured, you are too close and you need to fly higher or further away (or both).

3) Fly the orbit and start by pointing the camera at the selected feature and starting a raw video recording (**REC CAM** or **REC** button).

4) Zoom the camera to full narrow FOV (zoomed-in all the way).

5) Zoom out slightly, only a few degrees, then pause for 2 seconds. Repeat this process until the camera is at its widest zoom. This will create a video recording with a number of different zoom level "steps" that will be used for calibration.

6) Pan the camera to capture parallel-running streets at 90° to either side of the vehicle. While doing this, capture a minute of video at various zoom levels. Repeat steps 4-6 for all sensors.

7) Stop Recording video.

8) Copy and share video after landing or complete the "on the ground *or* while flying steps" that follow.
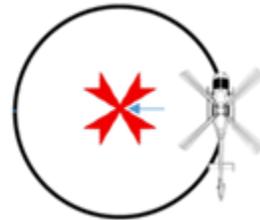
On the ground *or* while flying

1) Using live or recorded video in *Video-Mode*, identify a set of parallel roads and observe them as they approach a vertical orientation. Take note if the overlays are broader or narrower than the actual roads. Ignore any offsets at this point – only look for the width of the overlay versus the actual roads.

2) Enter the *Calibration Mode* via *Menu/Initial Setup/Calibrate FOV* (**CTRL+ALT+F11**) after observing any significant deviations.

3) Pause the video with the **Pause** button (**CTRL+X**) once the vertical roads are visible.

4) Press **START** in the upper right corner to display the Arrows and Commands.

5) Use the arrows keys to align the image. Note that this alignment is *ONLY* for calibration purposes and is not saved. It allows operators to efficiently change the size of the roads.

6) Change the size of the road overlays to best match roads in *Video-Mode* using the **+** and **–** buttons or the **SHIFT+UP ARROW** and **SHIFT+DOWN ARROW**.

7) Resume the video and verify that road overlays are more accurate. Repeat the process at both the widest and narrowest zoom levels, and for each sensor, as necessary.

8) If there are any errors, press the **RESET** button (**CTRL+ALT+R**) to clear the calibration.

9) When finished with the current zoom level, click the **NEXT** button or **CTRL+ALT+F11**.

10) When done with all sensors and zoom levels, click the **SAVE** button or **CTRL+ALT+F11**.

11) Use the **CANCEL** button (**Esc**) to abort the procedure if necessary.

Diagnostics

Error Messages

ARS displays error codes to notify the operatory there may be issues with the system. Report critical errors to SHOTOVER Systems; critical errors display in red. Yellow warnings usually mean the system is waiting for GPS, INS, or some other aircraft system.

If operators are unsure of system functionality or errors, please bring concerns to our attention at support@shotover.com or (720) 744-3300.

General Troubleshooting

To assist SHOTOVER Systems Support Engineers, become familiar with taking screenshots and recording video. These two tools minimize communication problems and delays.

Ensure you have a flash drive inserted into the system and capture screenshots and videos of the problems that are occurring.

If Wi-Fi is available in the hangar (personal hotspots often work well, too), SHOTOVER Systems can recommend a Wi-Fi USB dongle that enables remote support and can perform small updates on the system.

Updating the system

Your support representative has three general options for providing updates. For larger updates, SHOTOVER Systems provides a new drive to swap out with an existing drive while operators return the old drive.

For smaller updates, SHOTOVER Systems provides an update electronically to be installed by the operator on a flash drive. If ARS has internet connectivity, the unit can be updated remotely.

In many cases, the Support Engineer requests the aircraft's current configuration before performing an update. Instructions are below for obtaining and sending that information.

Sending Your Configuration

Please follow the instructions listed below when asked to send configuration files:

Find your ARS version number via *Menu/Initial Setup/Diagnostics/General* where it appears on the top line of the displayed panel. Note the version as it impacts the following steps.

1) Insert a USB flash drive in the ARS Unit.

2) With the ARS unit on (ground power or ship's power), select the **Menu** (**M key**).

3) For ARS Versions older than 3.18, select *Menu/User Preferences/Save* (*or Export*) *Configuration*.

4) Otherwise, select *Menu/Initial Setup/Save Diagnostics*.

5) Retrieve the USB drive and insert it into a desktop computer with an internet connection.

6) For versions older than 3.18, locate the *ARS_(Aircraft)* directory on the flash drive. In Windows, right click on the folder and select *Send To/Compressed Zip Folder*.

7) Otherwise, locate the file *ARS_(Aircraft etc).zip*. ARS versions 3.23+ may have multiple zip files for specific aircraft. Make sure to gather all of them. For older versions, your support representative may need to remotely collect information for other instances of ARS, such as pilot displays and dual monitors.

8) Notify your support engineer and send the .zip files to us by using a web browser to accesses our secure upload side at: http://shotover.com/upload

File Naming Customization

ARS supports customization of the file name saved by ARS (screenshots, markers, layers, and recordings). This information can be useful to identify or differentiate the data captured in the aircraft.
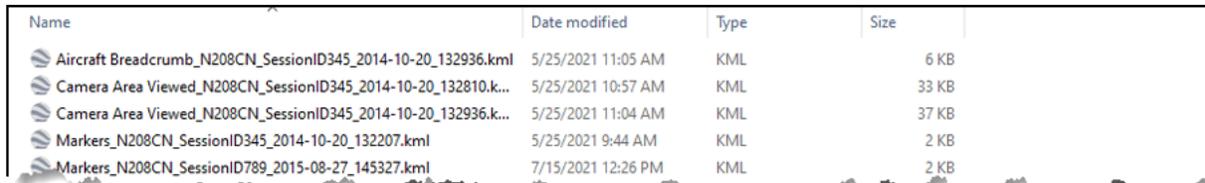
Name	Date modified	Type	Size	
Aircraft Breadcrumb_N208CN_SessionID345_2014-10-20_132936.kml	5/25/2021 11:05 AM	KML	6 KB	
Camera Area Viewed_N208CN_SessionID345_2014-10-20_132810.k...	5/25/2021 10:57 AM	KML	33 KB	
Camera Area Viewed_N208CN_SessionID345_2014-10-20_132936.k...	5/25/2021 11:04 AM	KML	37 KB	
Markers_N208CN_SessionID345_2014-10-20_132207.kml	5/25/2021 9:44 AM	KML	2 KB	
Markers_N208CN_SessionID789_2015-08-27_145327.kml	7/15/2021 12:26 PM	KML	2 KB	

The following list provides an example of parameters that can be added by contacting SHOTOVER Systems support.

- Session ID
- Agency Name
- Data type (screenshots, markers, layers, and recordings)
- Data Subtype (for shape files polygon, point, line)
- Aircraft Tail Number
- Name (in the case of recordings, the prefix)
- Use UTC instead of local time
- Custom data

ARS Integrations & General Features

This section outlines examples of the myriad of devices with which ARS can interface. When considering the overall integration, examine what other mission equipment and services are available to determine if ARS can assist with their operation.

Downlink Systems

All downlink systems auto-enable/disable to preferred preset based on altitude.

Downlink vendors:
- o Troll
- o IMT Skymaster
- o Vislink HDX, HD3
- o BMS
- o DTC
- o Janteq
- o SHOTOVER Systems' Earthscape live streaming via cellular LTE

Antenna pointing:
- o Vislink Pylon – Software-steerable fixed antenna
- o Troll
- o Directed Perception/FLIR PTU-D47 – Pan Tilt device for Silvus ground tracking antennas

Dynamic Position Systems

The position of beacons, vehicles, vessels, aircraft and more can be dynamically displayed in ARS to assist with situational awareness and locating.

Direction finders:
- o LoJack
- o Rho-theta – Multi-frequency, including LoJack

AIS – Marine vessel location information

ADS-B – Aircraft location information

AVL – Automatic vehicle location

Cursor-on-Target (CoT) ATAK – Blue force tracking and coordinating with ground units

JSON API – Interface to allow customization and remote access to ARS functionality

AXNes wireless intercoms – SAR / hoist operation personnel tracking

Computer-Aided Dispatch (CAD)

CAD integration can provide calls for service information as well as vehicle and personnel location information. In lieu of integration, an on-screen button can be added to minimize the ARS software to allow access to CAD software running on the ARS computer.

- o Motorola
- o GeoJSON (ArcGIS)
- o Sitaware
- o Raveon RavTrack AVL (Private RF network)

GPS / INS Systems

External GPS or INS systems are used for location data when the primary camera system is not available or not present.

- o Garmin Aviation Format
- o GDL90 – Traffic information
- o NMEA in & out – NMEA can also be sent to another device via serial or ethernet.
- o Novatel
- o Hemisphere
- o Chelton
- o Trimble
- o INS - OXTS
- o IMU - LN100

Gimbals

ARS can display and record a maximum of two video inputs from the same or different sources. Many gimbal integrations support automatic camera steering and line/path/shape-following.

- o Wescam MX series
- o FLIR 8500 series
- o FLIR 380-HD/HDc
- o FLIR UF
- o FLIR Talon
- o FLIR BRITE Star
- o FLIR Star SAFIRE
- o FLIR 230HD
- o Controp
- o Cineflex, SHOTOVER, GSS, Robinson
- o Cloud Cap TASE
- o POP300
- o SWE400
- o Safran
- o Elbit Spectro
- o UAV Vision

Searchlight Systems

Searchlight integration allows pointing at an ARS marker (direct or offset slaving).

- o Trakka
- o Nightsun
- o Thommen/Luminator
- o SLASS

Tactical Radios:

ARS interface capabilities with tactical radios allow geo-referenced channel/frequency switching based on aircraft location.

- o Cobham/Canyon AeroConnect RT7000 (partial)

ARS General Features:

- o Streaming video-out UDP/RTP/SRT
- o KLV-out via serial/UDP
- o Dual instances of ARS (e.g., Pilot+TFO or TFO+TFO)
- o Dual ARS consoles with interoperability (sharing of marker info and devices)
- o Tablet instance of ARS (pilot or second observer for independent control)
- o Dual gimbal video on ground stations (dual vehicle, dual stream)
- o Remote control of gimbal pointing with a bidirectional link to the aircraft

Other Integrations:

SHOTOVER Systems' ION remote status and REC toggling

Intterra (COWIMS) – cloud service for Colorado's Multi-Mission firefighting aircraft

Moog Stores Management Solutions (SMS) (partial)

Archangel ADAHRS

Nikon Still Camera - Allows capturing JPG with overlaps for later use in mosaicking software

Synthetic Aperture Radar – IMSAR STANAG 4607

ForeFlight – Camera TGT indicator

Vision tracking – Sentient/Kestrel

Pilot Display – iOS app (video + data) or Android (data only)

Touchscreens (multitouch preferred)

Keyboard Controls (Hotkeys)

Hotkey shortcuts have been programed to allow most ARS features to be selectable using only the keyboard.
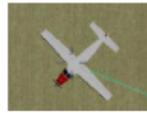
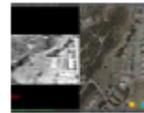| F1	F2	F3	F4	F5	F6
Camera	Map on Camera (Target)	Map on Marker	Map on Aircraft	Split Screen	Compass Orientation

BASICS

C	Displays on-screen compass and Speed of camera movement
I	Toggles between display of different map types
O	Toggles overlay and address info on and off
ALT+O	Toggles overlay in split screen
V	Toggles between measurement tool and speed tracking
2	Takes a screen shot
M	Opens the menu
BKSP	Previous menu
1	Toggles between target locations information and recorder status bar
3	Intersection information toggle
4	Marker detail toggle
L	Less/More user interface toggle
Q	Image improvement toggle (haze filter)
F	Fade between Live video and synthetic imagery
ALT+P	PIP toggle
ALT+F	Toggle projection
ALT+I	Invert PIP
CTRL+P	Select PIP source
U	Show Underground map
W	Waypoint display
ALT+J	Follow pattern with aircraft
ALT+H	Follow pattern with camera

SEARCH

SPACE BAR	Search
SHFT + BKSP	Clear entry field
TAB	Switch fields
ARROW KEYS	Switch tabs
ENTER	Select Result
ESC	Exit Search

MARKERS

A	Display additional marker info (coordinates, notes, etc.)
D	Delete current
E	Lock marker
G	Slew camera
N	Next
P	Previous
X	Mark Spot
ALT+E	Go to locked marker
ALT+X	Name
ALT+D	Delete All
ALT+V	Clear measurement markers only
ALT+G	Locks onto moving markers

MAP MOVEMENT

UP ARROW	Move map up
DOWN ARROW	Move map down
RIGHT ARROW	Move map right
LEFT ARROW	Move map left
PAGE UP	Zoom In
PAGE DOWN	Zoom out
(+) PLUS KEY	Zoom in (alternate). Can be combined with page up to zoom in quickly.
(-) MINUS KEY	Zoom out (alternate). Can be combined with page down to zoom out quickly.

LAYERS

ALT+L	Create a new layer
CTRL+L	Last layer
ESC	Exit editor
D	Delete/Move/Name toggle
N	New Shape
T	Toggle layer type
P	Search pattern dialog
X	Create point
ALT+D	Delete all shapes
ALT+N	Layer info

RECORDER/PLAYBACK

CTRL+X	Pause
CTRL+I	Live
CTRL+K	Move to Beginning
CTRL+S-J	Rewind
CTRL+W-U	Fast forward
ALT+Y	Record toggle
ALT+U	Screen Record toggle (ALT+Y may also be used if multiple sources are recordable)
CTRL+Q	Skip to next marker in playback
CTRL+A	Skip to previous marker in playback
CTRL+ALT+A	Speed up playback
CTRL+ALT+Q	Slow down playback

Terminology

ACFT: Aircraft.

ADS-B: Automatic Dependent Surveillance Broadcast. Used by aircraft to indicate latitude, longitude, altitude, and identifier.

AIS: Automatic Identification System. Used by marine vessels to provide locations and identifiers.

AVL: Automatic Vehicle Locator. Used by many agencies to keep track of moving targets.

FOV: Field of View. Describes the zoom level of the camera.

GIS: Geographic Information System. Describes a system that deals with geographical data.

HCU: Hand Control Unit.

IMU: Inertia Measurement Unit. Measures the heading, pitch, and roll of the aircraft.

INS: Inertial Navigation System. Integrates an IMU with GPS data to provide full positional data.

LOS (Line of Sight): An imaginary line extending from the camera lens to the TGT. The slant range is the distance of this line.

MGRS: Military Grid Reference System.

POI: Point of Interest.

TGT: This indicates where the camera is pointed.

UTM: Universal Transverse Mercator.