System Overview
Of the
Open Skies
Data Annotation, Recording, and Mapping System
(DARMS)

Version 2.1

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1. SCOPE

1.1 Identification

The information contained in this document applies to version 2.1 of the DARMS software. This document was prepared as an overview of the DARMS for use in the US Certification Book. More detailed descriptions are available in the DARMS Users Manual and DARMS System Specification. The DARMS was designed to provide overall system control for the full suite of sensors allowed for under the Full Implementation provisions of the Open Skies Treaty. Upon first Certification, only the film sensors will be certified. For the first Certification, the portions of this document that refer to the video, infrared and synthetic aperture radar (SAR or SAROS) should be disregarded.

1.2 System Overview

The DARMS is a digital computer system with the following functions.

- The primary system function is the annotation of mission data (as required by the Open Skies Treaty) onto media to store image data collected by the Open Skies sensor suite.
- The second function is the collection of sensor status, mission events, and navigation data and the storage of this data onto non-volatile media for post-mission analysis.
- The third function is the integration of digital map information, mission planning (waypoint) data, sensor status, aircraft navigation information, and other data to generate a continuously updated map display of the current aircraft location, predicted or actual sensor coverage, planned or actual mission track, and related information. This feature provides the operators and observers with a current situational awareness of the status of all sensors and related equipment.

The sensors, which interface with DARMS, are an Optical Camera Suite (OCS) (consisting of two obliquely mounted framing cameras, one vertically mounted framing camera and one panoramic camera), an Infrared Line Scanner (IRLS), a Synthetic Aperture Radar (SAR), and a Vertical Down Looking Video (VLV with on-demand recording and real-time display. At this time the IRLS, SAR and VLV are not ready for certification so only partial details will be given on the DARMS interface to these sensors.

In addition, the DARMS provides operator control, status display functions, and a limited built-in-test.

1.2.1 System Block Diagram

The DARMS sub-systems and its interfaces with Open Skies sensors, displays, and other equipment are shown in the DARMS Functional Block Diagram shown on the following page (Figure 1).

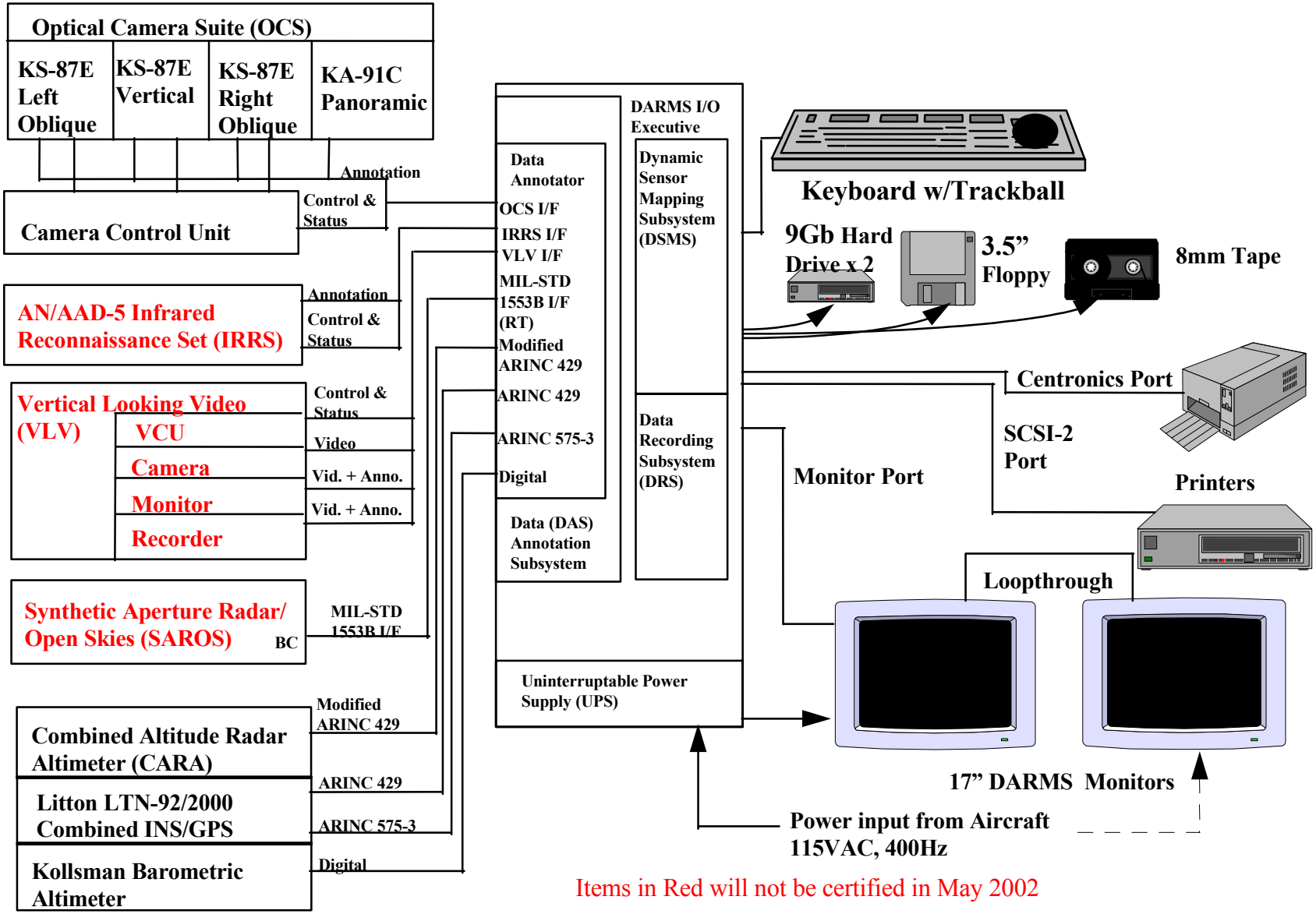


Figure 1. DARMS Functional Block Diagram

1.2.2 System Hardware Components

The three primary Line Replaceable Units (LRU's) of the DARMS system hardware are the Uninterruptible Power Supply (UPS), the Data Annotator (DA), and the SUN Computer. All three components are ruggedized for flight and designed to be rack mounted in a standard 19" electronics rack.

1.2.2.1 Uninterruptible Power Supply

The UPS is a 1.5 K VA power unit that sustains 400 Hz single-phase power to the Data Annotator, SUN Computer, and the mission commander's console monitor. If the aircraft power is lost, the UPS battery will continue to provide power to the DARMS system for at least five minutes while an orderly system shutdown is performed. The health (status) of the UPS is available to the SUN Computer via an RS-232 data bus.

1.2.2.2 Data Annotator

The DA provides annotation to the media used by each of the OC-135B sensors, automatically while a sensor is running. The DA also interfaces to other aircraft avionics system to obtain navigation and sensor parameters that must be annotated. Navigation and altitude data are received from aircraft systems and combined with operator inputs for annotation. Flight data and sensor status are transmitted to the SUN Computer for recording while commands and operator inputs are received by the Sun Computer for controlling annotation.

1.2.2.3 SUN Computer

The DARMS Computer is a ruggedized SUN, SPARC 20 / Model 61, workstation with 128 Megabytes of RAM. Two 9 Gigabyte hard drives, an 8 mm tape drive, and a 3.5" floppy disk drive are included.

1.2.3 DARMS Software

The DARMS computer software contains modules which incorporate the algorithms that process sensor data, avionics status, user inputs, and stored map data to produce outputs in the form of annotation of recording media, recorded data and a real time moving map display. As shown in Figure 2, DARMS software is partitioned into three main functional modules plus an Executive Controller that provides control over these three modules and provides the interface to the user. The three functional modules are the:

- Data Annotation Subsystem (DAS),

- Data Recording Subsystem (DRS), and the
- Dynamic Sensor Mapping Subsystem (DSMS).

The overall DARMS software architecture is shown in Figure 2 along with a top-level data flow diagram shown in Figure 3. The DAS, DRS, and DSMS are designed to be functionally independent such that the following functional priorities are maintained:

(a). If the DSMS software functions fail, no degradation of the DAS or DRS performance occurs,

(b). If the DRS software functions fail, no degradation of the DAS performance occurs and degradation of DSMS is minimal.

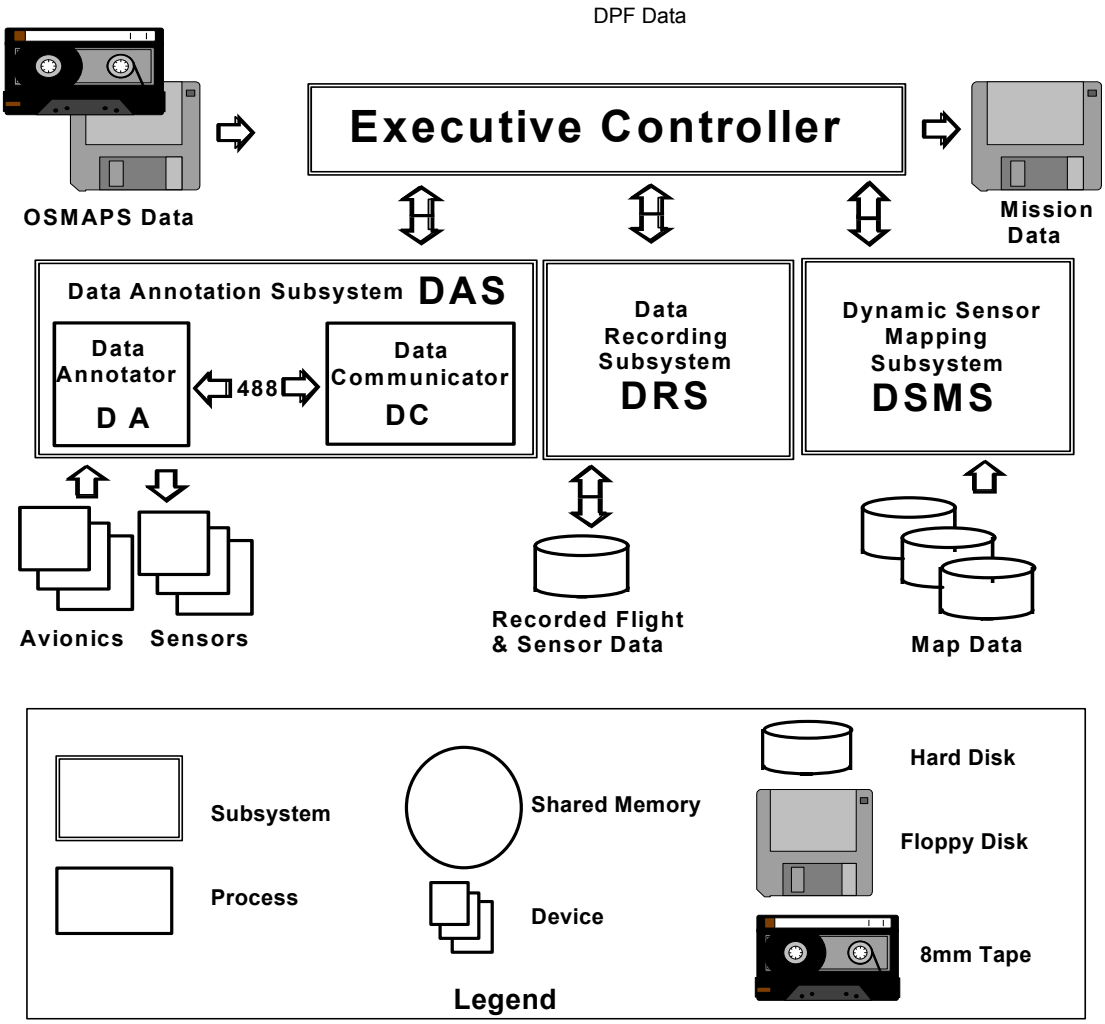


Figure 2. DARMS Software Architecture

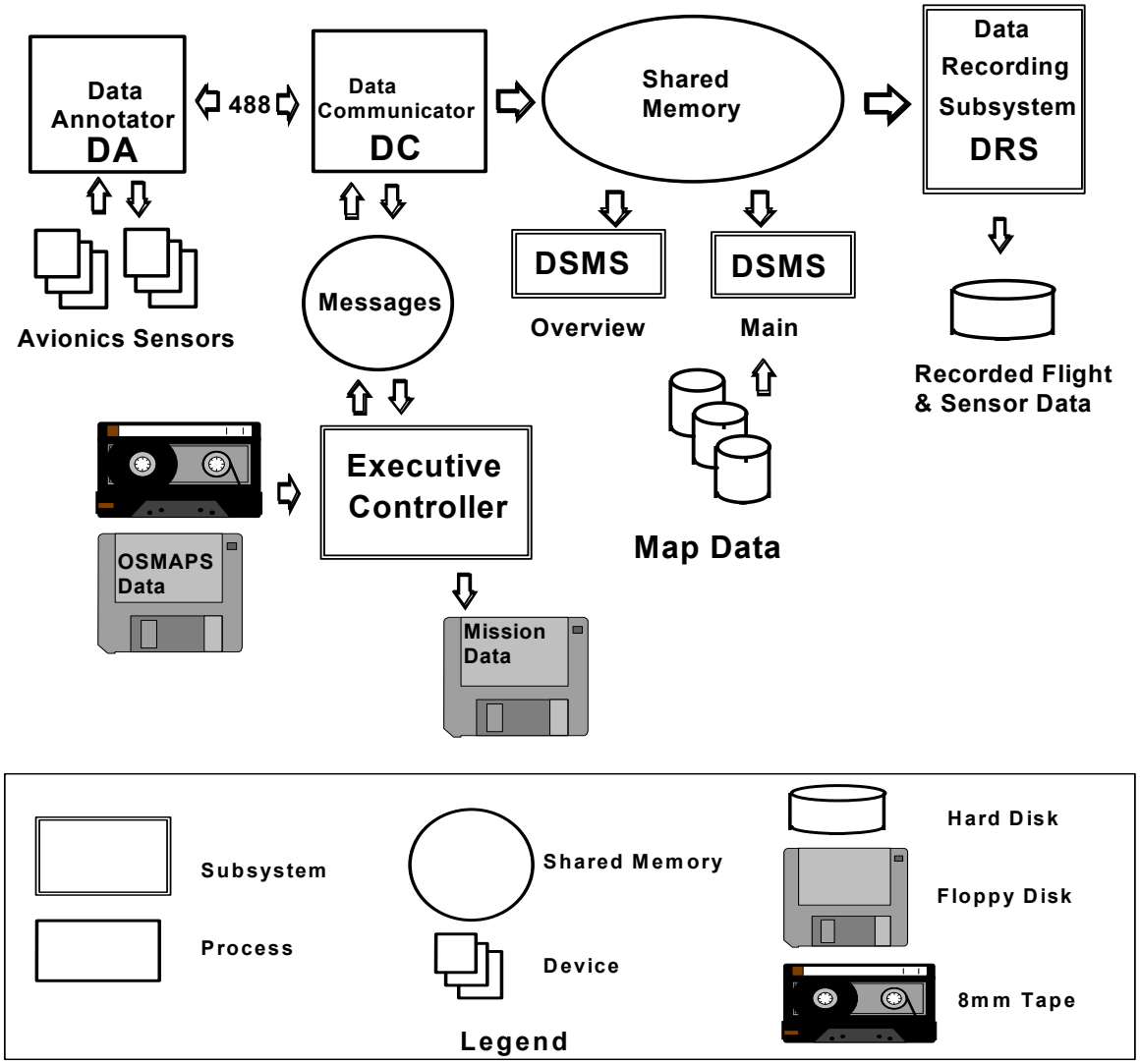
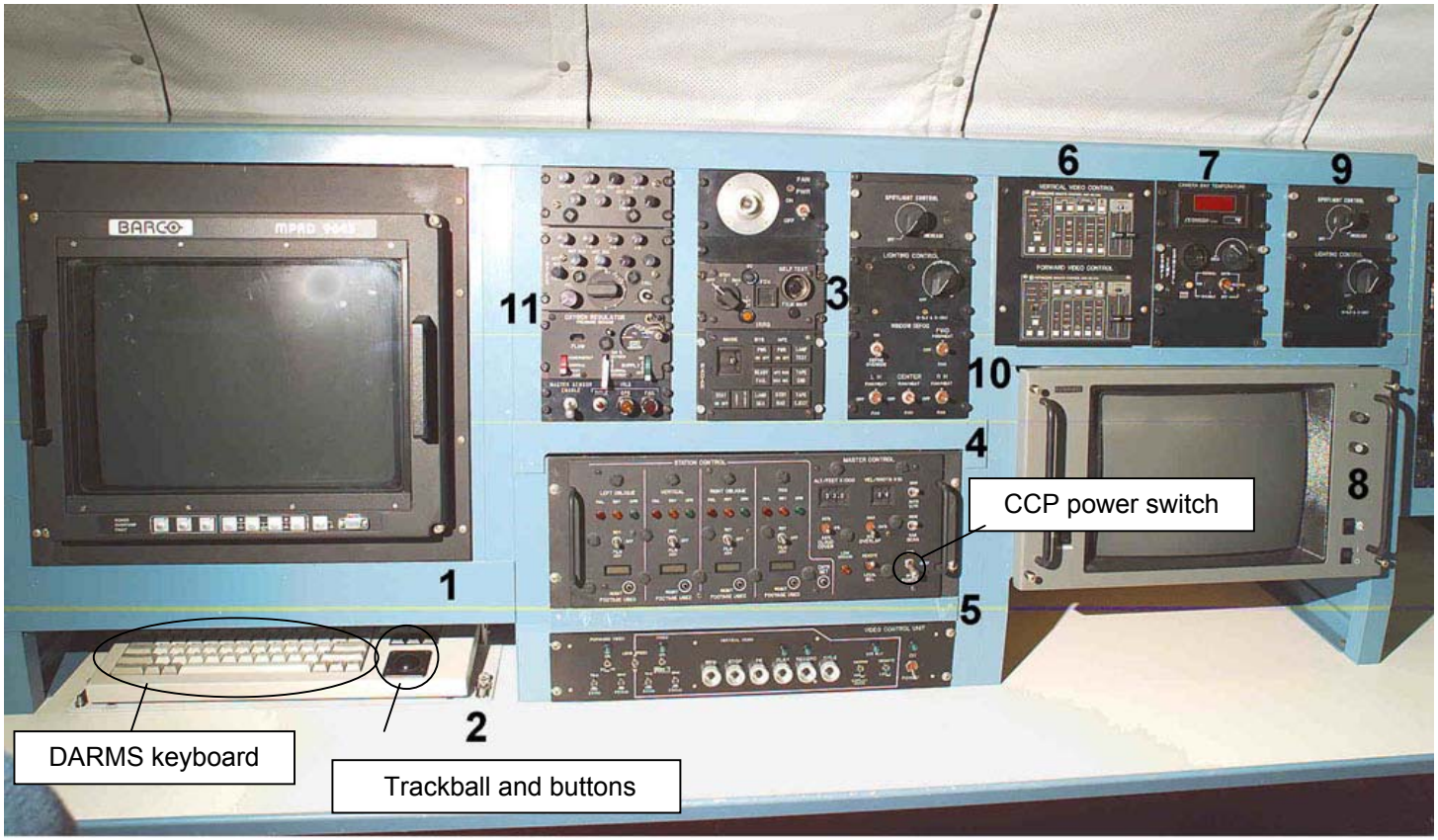


Figure 3. DARMS Data Flow

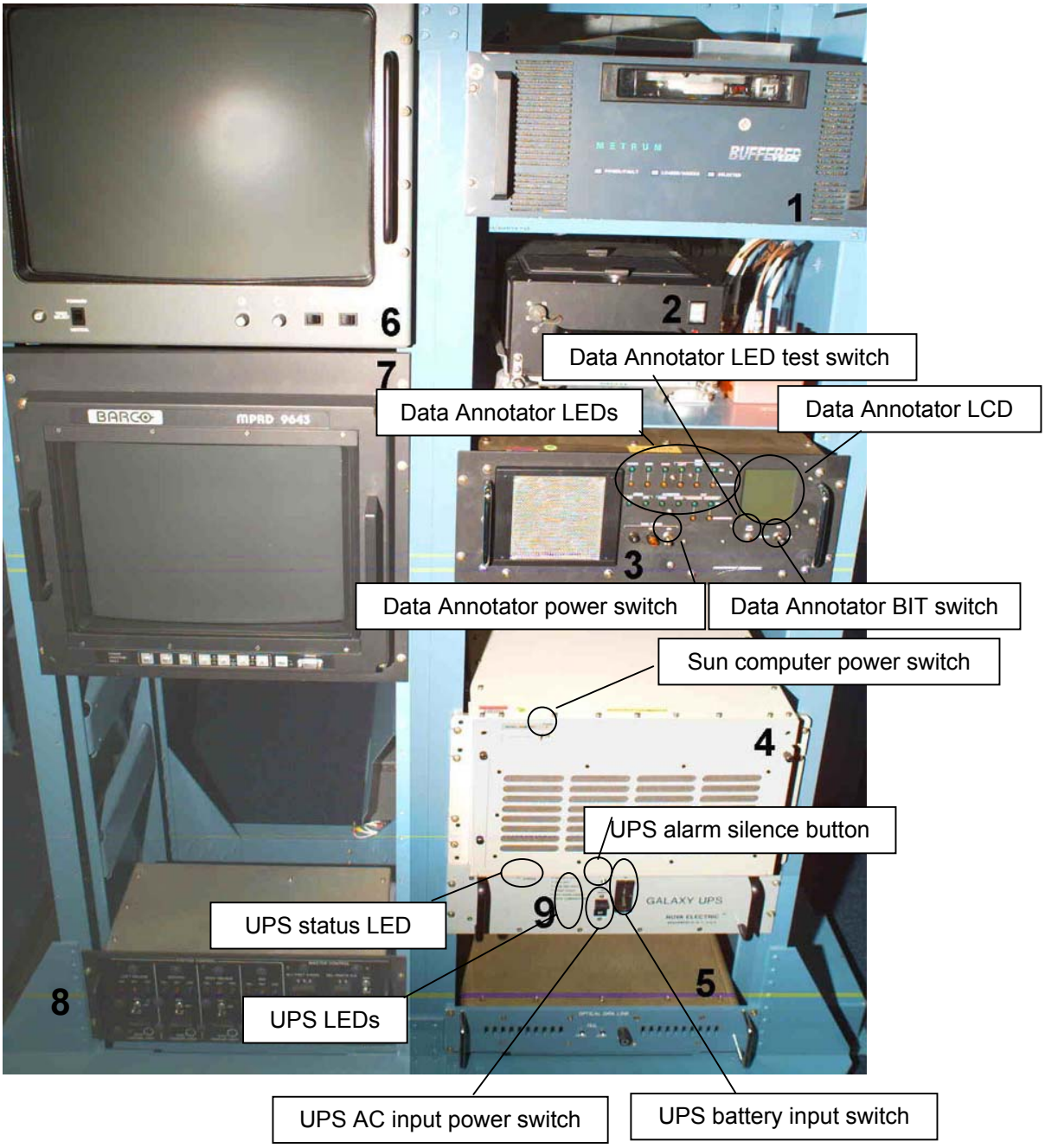
1.2.4 DARMS Sensor Control Station and Equipment Rack

The DARMS sensor control station and equipment rack contain the various equipment, switches, and indicators used to control the DARMS system. Figures 4A, 4B, 4C, and 4D provide photographs of the equipment used and locations.

Figure 4A. DARMS Sensor Control Station



1. Sensor Control Station DARMS Monitor
2. DARMS Keyboard
3. IRRS Control Panel
4. Camera Control Panel (CCP)
5. Video Control Unit
6. Video Control Panels
7. Camera Bay Temp. Display & Control
8. Video Monitor
9. Lighting Control
10. Window Defog Controls
11. Oxygen/Intercom Controls



1. SAR Tape Recorder
2. Vertical Video Tape Recorder
3. 1924 ROS Data Annotator (DA)
4. DARMS (Sun) Computer
5. SAR Optical Data Link
6. Mission Commander Video Monitor
7. Mission Commander DARMS Monitor
8. Spare Camera Control Panel
9. Uninterruptible Power Supply (UPS) for DARMS Computer

Figure 4B. DARMS Equipment Rack

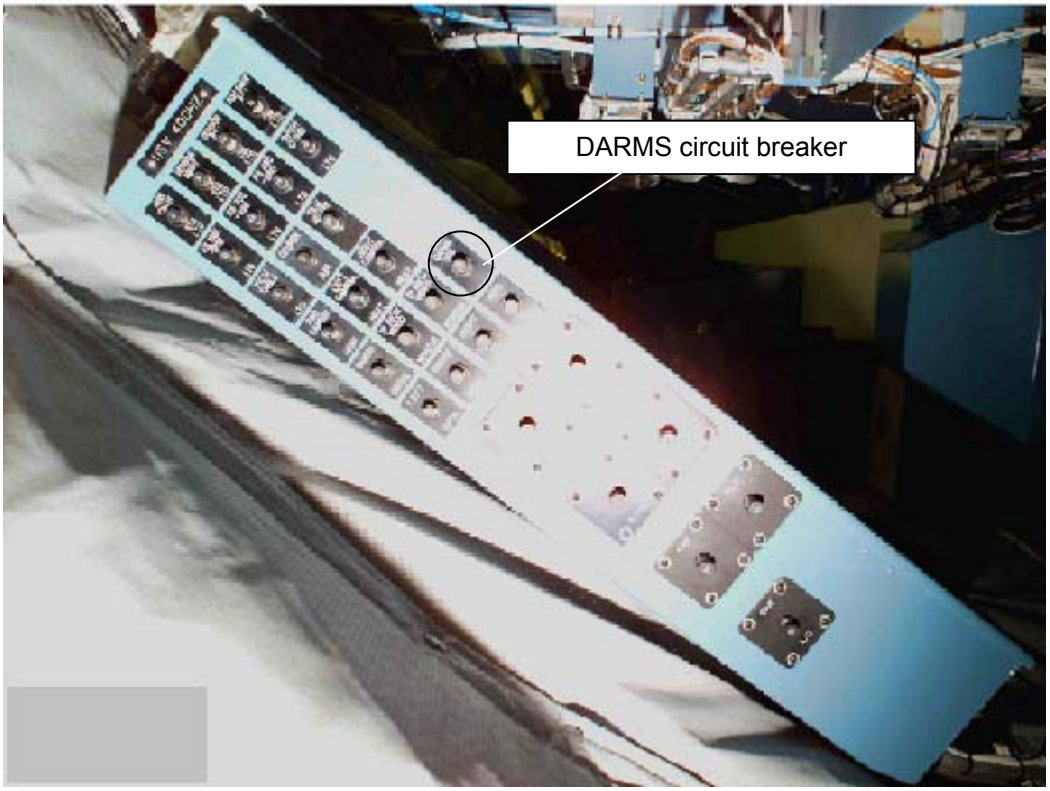


Figure 4C. DARMS Circuit Breaker

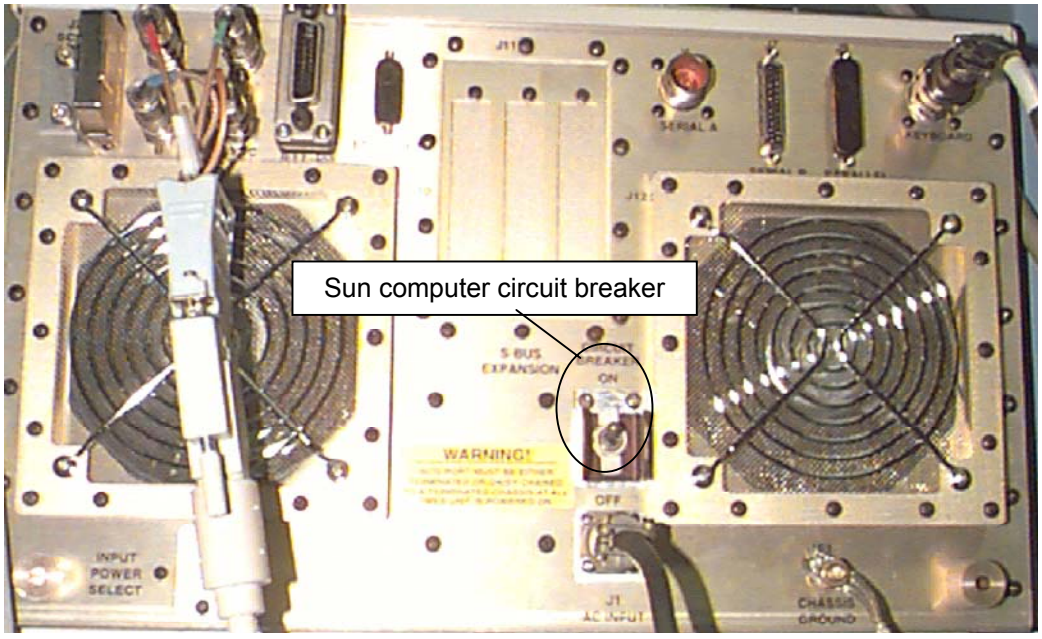


Figure 4D. Sun Computer Rear Panel Circuit Breaker

1.3 DARMS Media Annotation

The DARMS provides data annotation for sensor media as described in the following paragraphs. Note that for the US Certification occurring in May 2002, only the optical film Cameras will be operational.

1.3.1 KA-91C and KS-87E Film Annotation

Data annotated on the film of the KA-91C and KS-87E cameras are as shown in the Figures 5 and 6 below. Header / leader and frame annotation formats are as follows:

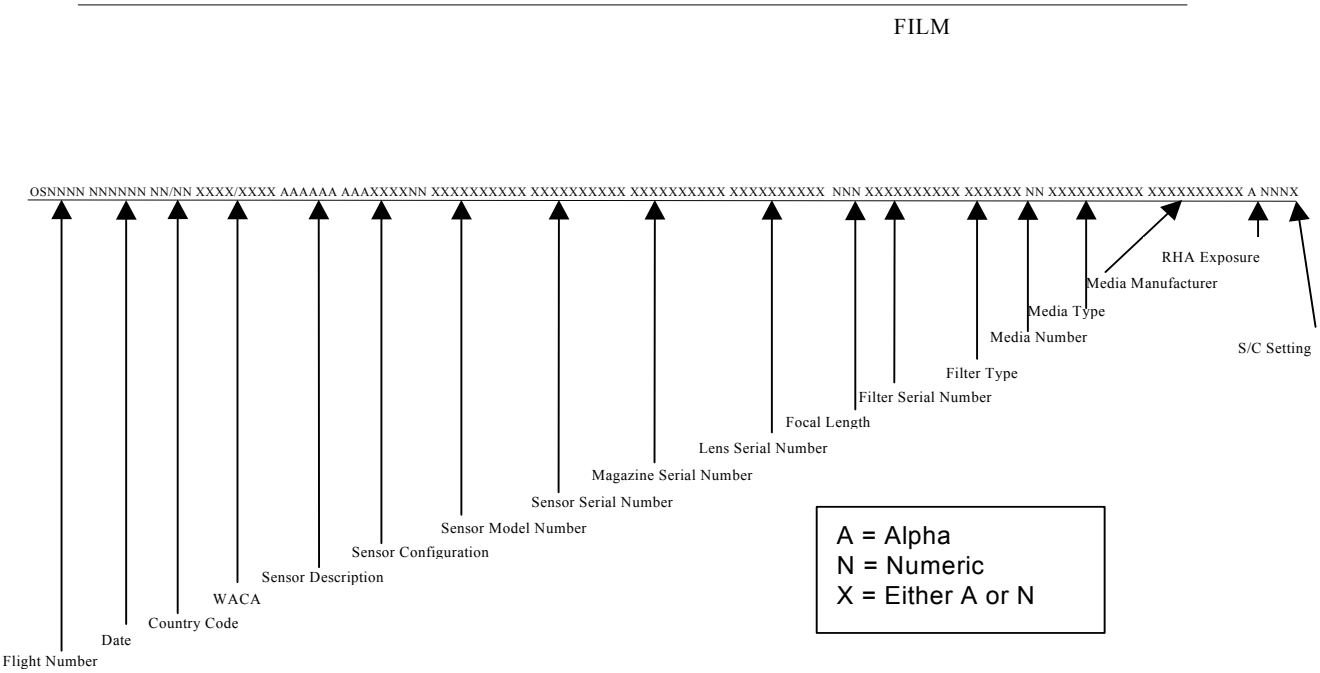


Figure 5. KS-87 and KA-91 Header Annotation

Figure 5 KS-87 and KA-91 Header Annotation (Shows maximum number of spaces allowed for each field, fewer may be used) Not to scale

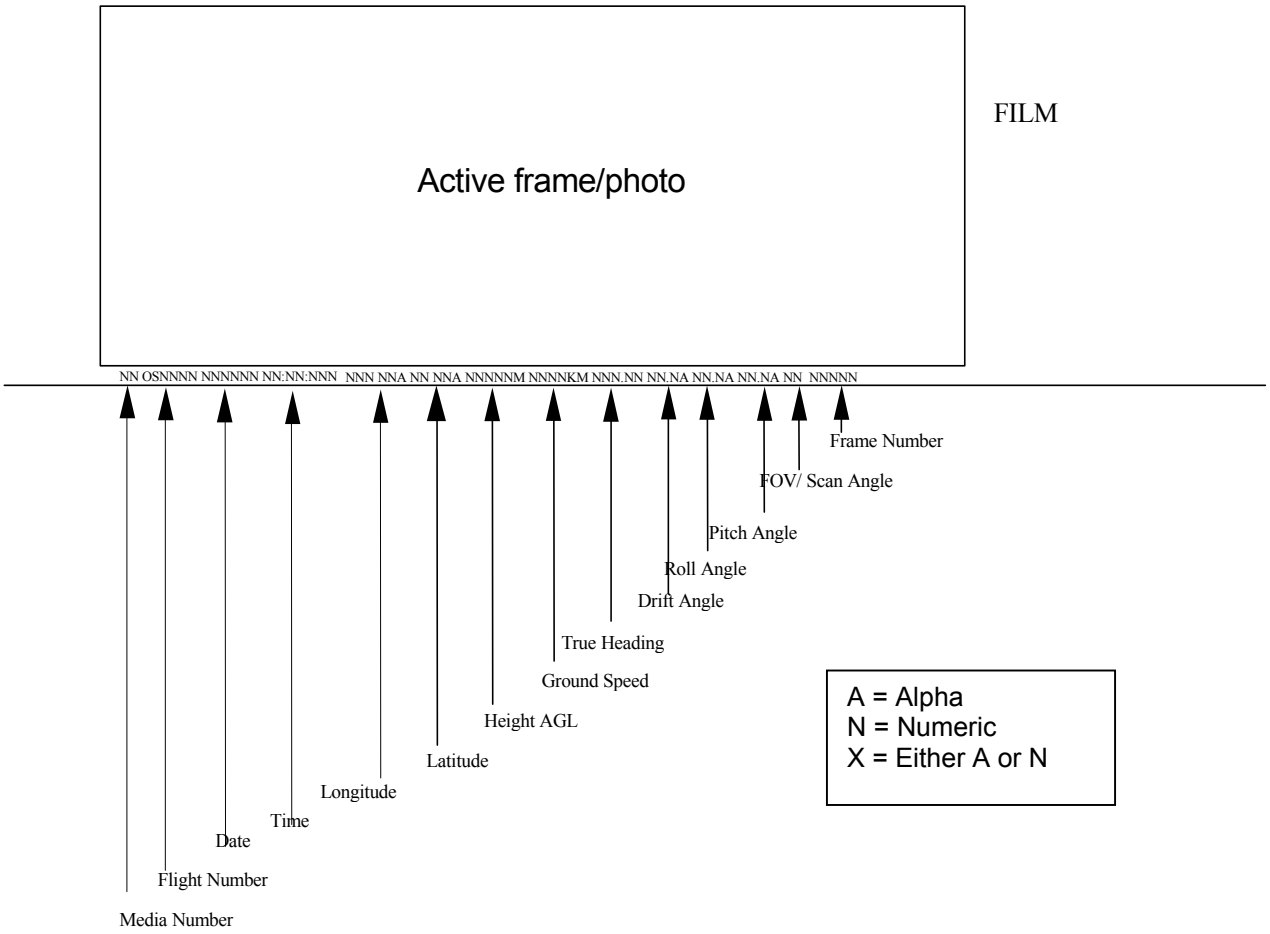


Figure 6. KS-87 and KA-91 Frame Annotation

(Figure 6 shows maximum number of spaces allowed for each field, fewer may be used, or zeros may be inserted) Not to scale

1.4 DARMS Digital Recording

In addition to recording the annotation fields on the sensor media as described in Section 1.3, DARMS also maintains a mission history of all the navigation data, sensor events, sensor annotation data, and the system error log. These parameters are recorded on the system hard drive and later transferred to a 3.5” floppy disk. In some cases the data is recorded to higher precision than that recorded on the media. This digital data is downloaded after the mission from DARMS into the US Transportable Operational Planning System (TOPS). The data is also provided, via TOPS, to both the US Open Skies Annotation Tracking and Plotting System (OSATAPS) and the US Open Skies Mission Planning System (OSMAPS). Complete details of the data recorded can be provided via the OSATAPS Interface Control document or DARMS Specification.