**IRIG 106 Chap. 10 - Solid State on-board recorder standard: Implementation of a Flight Test standard for advanced operational debriefing and aircraft maintenance**

At the end of the 1990s, recorders using solid state memory devices started to replace tape recorders.
In order to standardize this new kind of recorders for test ranges, a telemetry group was created to adapt IRIG 106 and write its “Chapter 10”.
This new addition to IRIG 106 defines not only a recording format for video, 1553, PCM, Arinc 429, …, but also recorder interfaces, Removable Memory Module (RMM) characteristics, command and control protocol and also RMM declassification.

Defining this standard, some operational requirements were also taken in account:

- RMM directory conforms to STANAG 4575 in order to have the ability to download the data on any STANAG 4575 compliant ground station
- Fast download time thanks to up-to-date interfaces
- MPEG-2 transport streams conform to MISP (Motion Imagery Standards Profile) so files can be easily exchangeable between all systems.
- Video and data are time tagged using either external time source like IRIG-B or the RMM embedded real-time clock. This way the RMMs of several aircrafts can be synchronized before mission, allowing a full synchronized multi-aircraft debriefing using both video and data.

Meeting these requirement allows for a test range recorder to be used for operational mission and aircraft maintenance.

Data format

The standard only defines the position of the first directory block on the RMM. This first block links to other directory block and each directory block links to one or several files.

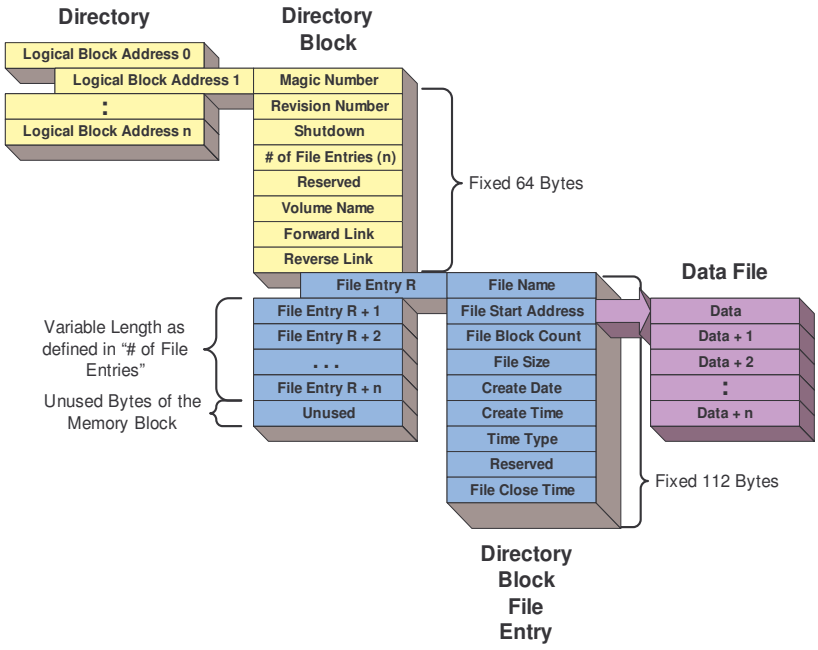


**Figure 1 Recording format**

For some operational programs, the RMM may also contain mission parameters to be uploaded in the aircraft's mission computer.
IRIG 106 chapter 10 does not define such upload data and how to store them on RMM. As only the first logical block of the RMM is defined by the standard and as all other blocks are linked to this first one, the RMM can be easily "split" in a recording area and an upload area. As first logical block remains an IRIG 106§10 directory block, the RMM will be fully compliant.

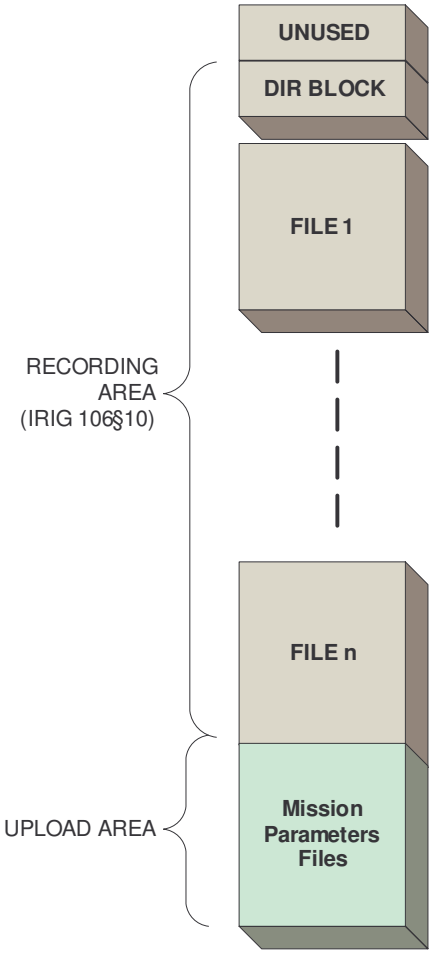


**Figure 2 RMM with Upload area**

The data are packetized in the files, constituting a multiplex of time tagged data from synchronous and asynchronous channels. A high resolution timer is used to synchronize the different channels.
At the beginning of each file, a TMATS packet gives the full description of the acquired data. This TMATS data can even contain all the parameters descriptions. Since ground system is capable of configuring itself using this TMATS packet, it is easy to add a new aircraft for any kind of exploitation including operation debriefing, and this only from the RMM or a ch10 file!

Removable Memory Module

The media for IRIG 106 chapter 10 recorders is based on solid-state memory. As Solid-State chips are used in more and more public devices like digital cameras, disk on key, MP3 keys, …, the price for a Giga Byte of solid state memory decrease quickly. It becomes a cost-effective solution comparing to other kind of media essentially because of its robustness and compactness.

In the next version of IRIG 106§10, RMM are equipped with a standard IEEE-1394B connector to allow fast data download to the host (1394B = 800Mb/s). Only a standard 9-pins cable is needed to connect the RMM to a PC and play back the data directly from the RMM.


**Figure 3 RMM with 1394B connector**

A simple protocol is defined for this interface. One of its essential features is the RMM's embedded real-time clock setting. 46$^{th}$ TW at Eglin AFB developed a portable device named "Jammer" where a GPS time reference can be set simultaneously on up to 4 RMMs. This real time clock can after be used as a recorder internal time source where no IRIG-B or other time distribution is available.

To complete the standard, a full sanitizing procedure to declassify the RMM is defined, based on a several erase/write process taking in account "bad blocks".

Recorder interfaces

A set of discrete lines to control and monitor the recorder is also defined in the standard.

Moreover, the recorder can also be commanded and controlled using the “old” protocol defined in IRIG 106 §6 for magnetic tape recorders. This protocol is based on simple ASCII messages where a simple Hyperterminal can be used to interface the recorder.

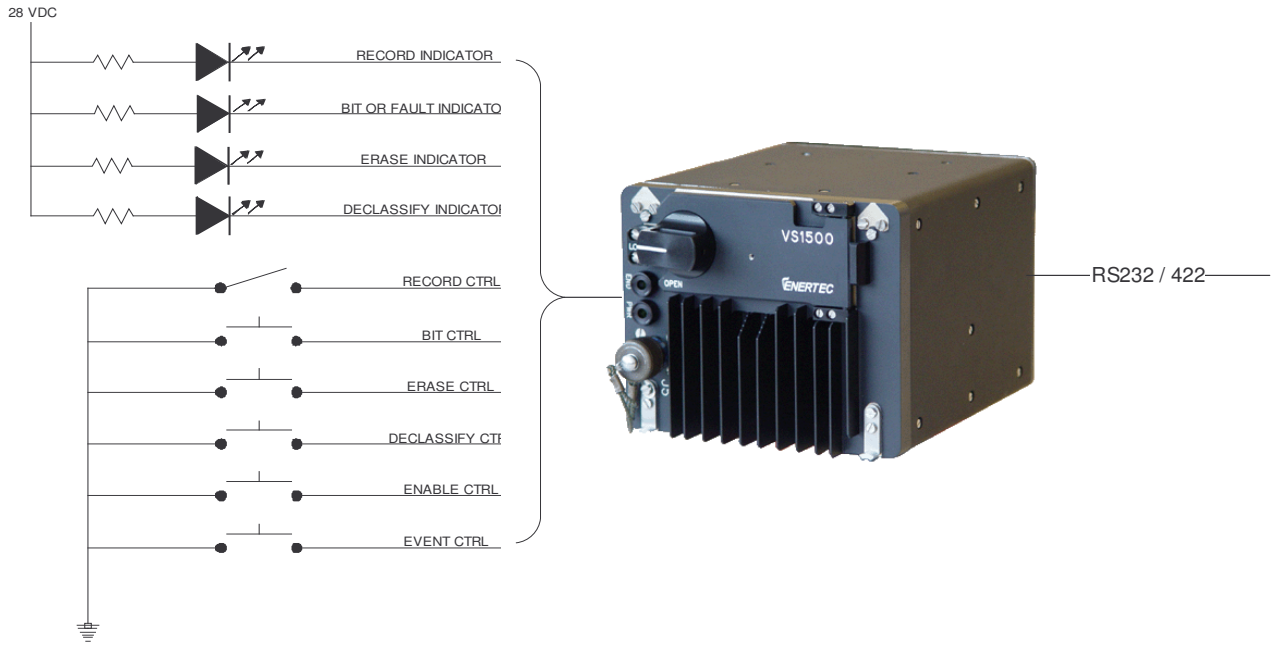


**Figure 4 Command and Control Interfaces**

For operations, the discrete lines will be used principally. The RS232/422 interface can also be used for monitoring the recorder. Using the recorder as a remote terminal on a MIL-STD-1553 bus allows also full command and control.

Operational use

IRIG 106§10 is primary a standard for test ranges, but as it was defined taking in account some operational needs; it can easily be used for operations.

| | Flight Test requirement | Operational requirement |
|---|---|---|
| Multi-channel recorder | X | X |
| Time tagged data to allow synchronized exploitation | X | X |
| High resolution time tag | X | |
| Fast Download | X | X |
| Simple exploitation system | X | X |
| Interoperability | X | X |
| Multi-ship debriefing | | X |

It gives a solution for complex debriefing where videos have to be replayed synchronously with data, showing flight path on 3D terrain, manoeuvres, ….
It also gives a solution for maintenance as all the parameters are acquired on-board, not only parameters needed for the debriefing. Lot of maintenance controls can be done analyzing these data.
Standardizing not only the data format on cartridge, but also the recorder and the RMM interfaces will increase compatibility between systems.
Using the same kind of recorders for test and operations will irremediably reduce the cost of these systems as they will be produced in larger quantities and there will be several providers for both recorders and ground systems.
At the same time, any aircraft will be equipped with a “test compliant” recorder.

As an example, IRIG 106§10 was mandatory for the replacement of video tape recorders on USAF A10 fighters…