# VEHICLE TELEMETRY DATA IN THE VERTICAL BLANKING INTERVAL

**Thomas J. Ryan**
**Senior Engineer**
**Instrumentation Development Branch**
**BDM Corp.**
**P.O. Box 416**
**Ft. Ord, Ca., 93941**

## ABSTRACT

This paper describes how three different developments in digital and video technology have been exploited to provide for the automatic retrieval of data from video tape recordings. By application of the technique of vertical interval data insertion, a pair of 50-bit digital "words" are inserted into two lines of each TV field. The digital words are assembled from a BCD representation of IRIG-B time and both serial and parallel digital data from instrumentation associated with the vehicle. Retrieval of digital time and data annotation from a composite video signal's vertical interval is automatic and yields editing commands and digital data reduction at 3x tape play speeds. This paper defines the functional requirements, describes the implementation concept and provides illustrations of the pragmatic solutions.

## INTRODUCTION

Background - The U.S. Army Combat Developments Experimentation Command (CDEC) currently operates an established Multiple Computer System at Ft. Hunter Liggett, Ca., which functions as a core facility for processing and analyzing data extracted from instrumented tactical elements engaged in the field in simulated battle scenarios. The core facility also includes an Integrated Information Control Center which provides exercise monitoring, control, and feedback functions. These exercises involve the employment of instrumented combat troops, tactical vehicles, armor and aircraft as players in these simulated engagements. The scenarios are designed to provide a realistic environment for the evaluation of forces, tactics and weapons in simulated combat.

A position location system using a discrete addressable beacon/transponder with two-way telemetering capabilities is located on each instrumented player. Amongst the sophisticated player instrumentation systems, television cameras and video tape recorders are used to bring back important battle events and data. A time code generator synchronized to IRIG-B time annotates the video raster (picture) with seven numeric time characters and four event flags. Manual post-trial data reduction has been required.

Identification of the Problem - Manual post-trial data merging and reduction from telemetered data and TV recordings became a quantity and quality problem. A need was identified to automate the data reduction from the video tape recordings to minimize errors induced from human efforts and cope with the overwhelming volume of data produced by the field trials in a timely manner.

Implementation Concept - Automatic data reduction starts with inputting the data (time and events) on the video tape at the player. For a pragmatic approach:

- Digital format is easy to extract and ready to use.
- Insert data and time into vertical interval (blanking lines).
- Identify collated data source on player (telemetry line).
- Keep it simple on the player.
- Put the intelligence into the playback facility.

## VERTICAL INTERVAL DATA INSERTION

Digital Format - Since the goal was to provide for automated data reduction and merging, a digital format for the data insertion was the obvious choice.

Choice of Vertical Interval for Data Insertion - Television industry standards have permitted the use of the vertical blanking interval lines 17 and continuing through line 20 of each field of be used for test, cue, and control signals. Line 19 is specified for the standard Vertical Interval Reference (VIR) signal.

Some instrumentation TV systems have made use of data insertion at a one bit per line rate following the horizontal sync back-porch giving rise to data appearing as a thin vertical line at the left edge of the raster.

Two reasons lead to the choice of the vertical interval. One, it is a standard. Two, when tape players are in a slow or stop action mode, there can be a horizontal band of “head” noise which would yield an all-or-nothing output of the data lines.

Identify Collated Data Sources - The current vehicle instrumentation gathers multisensor data and formats it into a 42-bit serial digital word for use by the existing telemetering system. Additional parallel data sources on the vehicle also exist (switch closures). The IRIG-B time is represented in parallel digital format in the time code generator prior to conversion to characters for annotation of the video raster.

These three different dynamic and asynchronous serial and parallel data sources have been merged with four sync pulses to produce two 50-bit digital words, one for each of two vertical interval lines (lines 17 and 18). Figure 1 illustrates the timing format of the data inserted into the video. Note that the first two bits are hardwired to reference level white and to the blanking level to serve as sync pulses.

The bit assignments for the inserted data have been established as follows:

- LINE 17; Bits 1 & 2, sync; 3 thru 26, BCD IRIG-B time; 27 thru 30, event flags; 3, status bit; 32 thru 50, parallel data.
- LINE 18; Bits 1 & 2, sync; 3 thru 44, serial data; 45 thru 50, parallel data.

The inserted digital data lines are not apparent on a TV monitor screen as they reside in the blanking interval, but would appear as illustrated in Figure 2 if the vertical sync were adjusted to make them visible. The time and event numeric characters are shown in the raster and the two 50-bit digital words are shown in the blanking interval at the top of the picture.

Functional Description - The function of the Video Time Code/Digital Data Inserter (VTC/DDI) is to annotate a RS-170 standard composite-video signal from a CCTV camera with IRIG-B time, four event flags and digital data. As illustrated in Figure 3, VTC/DDI Deployment Block Diagram, a time code generator is part of the VTC/DDI and is capable of external synchronization to IRIG-B time. The local IRIG-B standard is used to synchronize a portable TCG which is then used in the field to synchronize each of the VTC/DDIs mounted on player vehicles during countdown prior to a field trial. The TCG in the unit generates the 24-bit BCD IRIG-B time and the 1 Mhz clock used by the data inserter.

Annotation of IRIG-B time is in both a 24-bit BCD digital format during the vertical interval, and also as seven (7) numeric characters impressed on the raster to indicate time to 0.1 second. The four (4) Event flags can be set from an external parallel-data source and the annotation is in a 4-bit digital format following the IRIG-B time during the vertical interval, and also as four (4) numeric characters impressed on the raster under the IRIG-B time. The digital data consists of a 42-bit serial-data word as input from the vehicle telemetering system with its clock and its start/stop gate.

The 42-bit serial data word is obtained from the vehicle instrumentation and was intended (and is used) for telemetry. It has random time of start with respect to the VTG/DDI timing but includes an enable gate and 200 kHz clock pulses adhering to a strict protocol. For most applications the word appears less than 10 times a second.

In addition to the previously mentioned digital data, provisions are made for 26 bits of parallel data input from the vehicle instrumentation.

## VERTICAL INTERVAL DATA RETRIEVAL UNIT (VIDRU)

Functional Description - The function of the VIDRU is to retrieve data from a RS-170 Standard composite-video signal having the vertical interval annotated with IRIG-B time, four event flag bits, and other digital data. The retrieval of IRIG-B time data outputs to an external parallel-data connector 24-bit BCD digital word extracted during the vertical interval and also outputs a front panel seven (7) numeric character display of hours, minutes and seconds to indicate time to 0.1 second. The four (4) event flags and one status bit are retrieved and output to an external parallel data connector. There are also five (5) front panel indicators for these event flags and status bit. The digital data designated as being from a serial source consists of a 42-bit parallel data word as output through an external parallel data connector and also drives 42 front panel indicators. In addition to the previously mentioned digital data, provisions have been made for retrieving the remaining 25 bits of parallel data and output to external parallel data connectors. The 96 bits of time and data were retrieved in digital format during two vertical interval lines.

Figure 4 depicts the VIDRU functional block diagram showing its I/O interfaces. The VIDRU emulates the actions of a TV data reduction operator/analyst using a tape player control console. The stop/start and data entry commands are outputs of the VIDRU to the Z6M editing console and/or the DEC-10 computer.

The data bits on lines 17 and 18 are loaded into a serial-in parallel-out register and, as previously mentioned, are made available as both front panel indications and as parallel outputs for external use. Internal signal processing by the VIDRU provides the output action controls to the video editing facility (Z6M editing keyboard) and the DEC-10 computer facility for data merging, analysis and reporting.

Event Bit Select and “STOP-ON EVENT” - A means has been provided on the front panel to select by miniature toggle switches any or all of the 72 parallel lines indicated on the 72-bit display to produce a “STOP-ON-EVENT” command. The three position switches permit selection of “0”, “1”, or “Don’t Care”. Any bit so selected is compared with the corresponding bit of the incoming data source. If any selected bit is found enabled it produces an appropriate “STOP-ON-EVENT” command, emulating an operator keyboard to the video tape editing facility. I

IN/OUT Time Select and “STOP-ON-TIME” - A means has been provided to load event time from the DEC-10 computer via a serial ASCII code and to feed these 24 bits of BCD time to an IN/OUT time decoder which compares the computer program time with the

24 bits of BCD output from the input video source. When the computer program time is found to be the same as the input source time it produces a “STOP-ON-TIME” command for that specific input video source. In addition to the above, a front panel switch marked “IRIG-B and “EDITOR” select has been supplied which, when in the EDITOR position, will not use the 24 bits of IRIG-B, but reformats the computer time for command to enter that time into the Edit Event/Time word generator. This capability permits DEC-10 access directly to the edit file memory and time-tag/conversion capability of the Z6M editor’s own microcomputer.

Edit Event/Time Word Generator - A means has been provided to input the two sources of “STOP-ON-EVENT” and “STOP-ON-TIME” commands (or the reformatted computer time words) and convert these commands to an output on 8-bit parallel ASCII that interfaces to an external multiplexer. These outputs are used between the Editor’s ASCII keyboard and the Z6M Controller of the video Tape Editing facility and emulate the operators action with keyboard entry of commands to the Z6M editing system.

Enter Data To DEC-10 Computer - A means has been provided to input all data bits in parallel from a given field of the input video source and then format an output to drive a data output line using serial ASCII format to a terminal interface port of the DEC-10 computer. The “ENTER” command has been made available as a front panel push-button. All DEC-10 data is supplied as 8-bit ASCII encoded with data rates selectable between 1200 and 2400 baud asynchronous. The I/O signal characteristics are selectable as either 20 ma current loop or EIA RS232C Compatible.

## CONCLUSIONS

As part of the function of long range planning and instrumentation development for the U.S. Army CDEC, it was determined that the quantity of CCTV video tape recordings were exceeding the capability to manually review, extract, merge, and evaluate the data. A concept was formulated to combine the IRIG-B time code with the available digital telemetry and other data and insert this information into the vertical interval of the composite video being recorded on the vehicles.

An analysis was conducted which compared the normal data extraction conducted on a recent experiment with that projected for the next one if done with manual data extraction.

| ITEM | TASVAL (1979) | ARMVAL (1980) |
|---|---|---|
| CCTV equipped players | 30 | 55 |
| Data elements per engagement | 12 | 37 |
| Engagements per trial | 82 | 51 |

| | | |
|---|---|---|
| Data elements per trial | 900 | 1732 |
| Man hours per trial | 48 | 92.4 |
| Man hours per day to keep current | 24 | 185 |

The analysis found that the greatly reduced search time (concurrent high-speed search and data extraction) and data element log time (one key stroke to enter event time rather than seven) cut the man hours in half. Two secondary advantages of this new capability have recently been identified. On-board recording of all digital telemetry data will permit verification of the RF link quality. Field instrumentation has always followed a growth in requirements for “just one more data bit” so the new system anticipated this need by including unassigned parallel bits for future growth.


## ACKNOWLEDGEMENT

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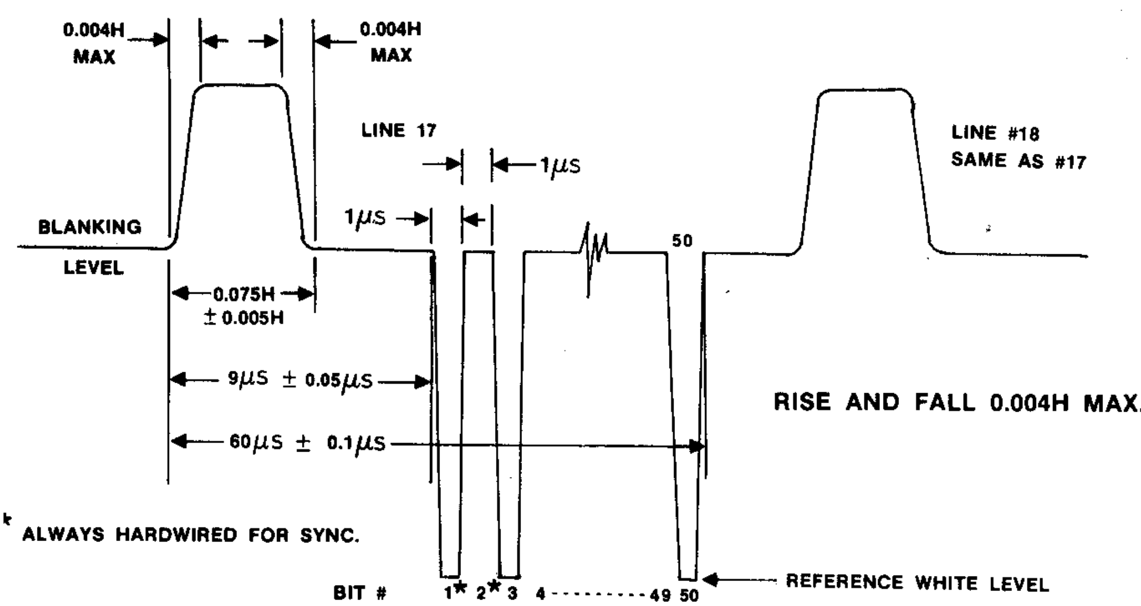


**Figure 1. VTC/DDI Timing Format**

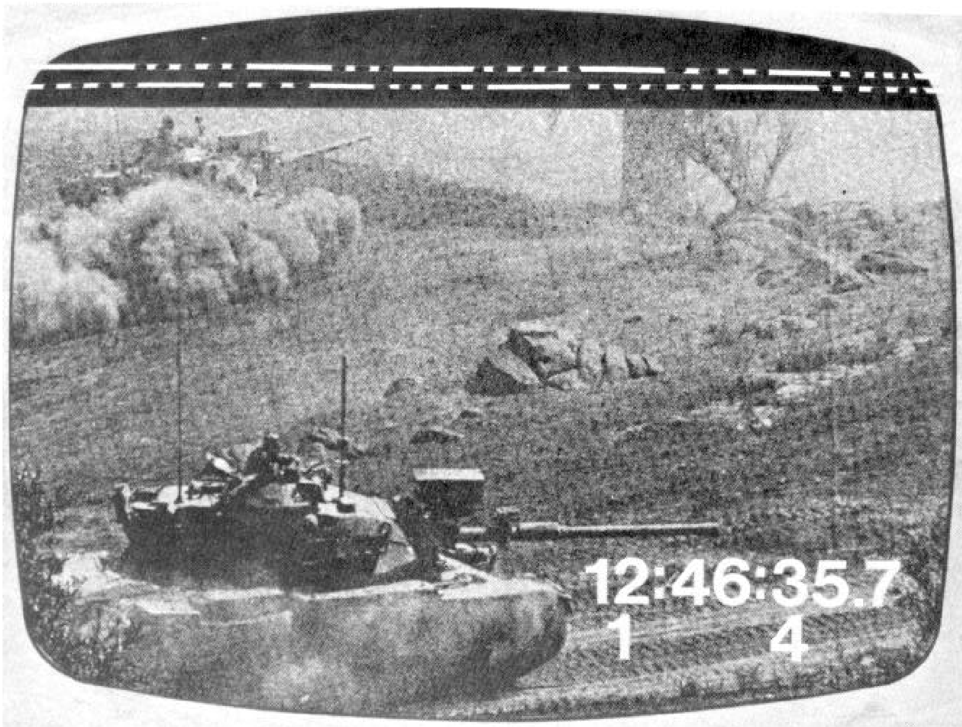


**Figure 2. Typical Video Annotation By VTC/DDI**

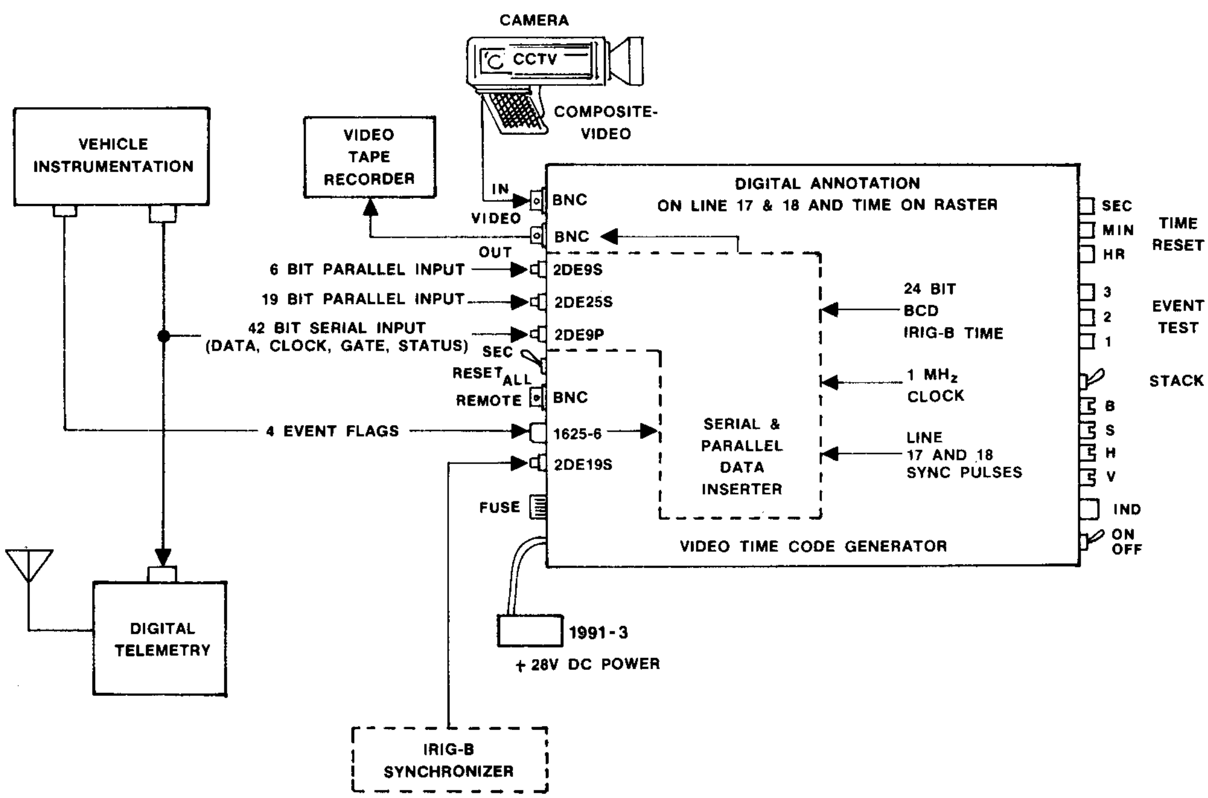


**Figure 3. VTC/DDl Deployment Block Diagram**

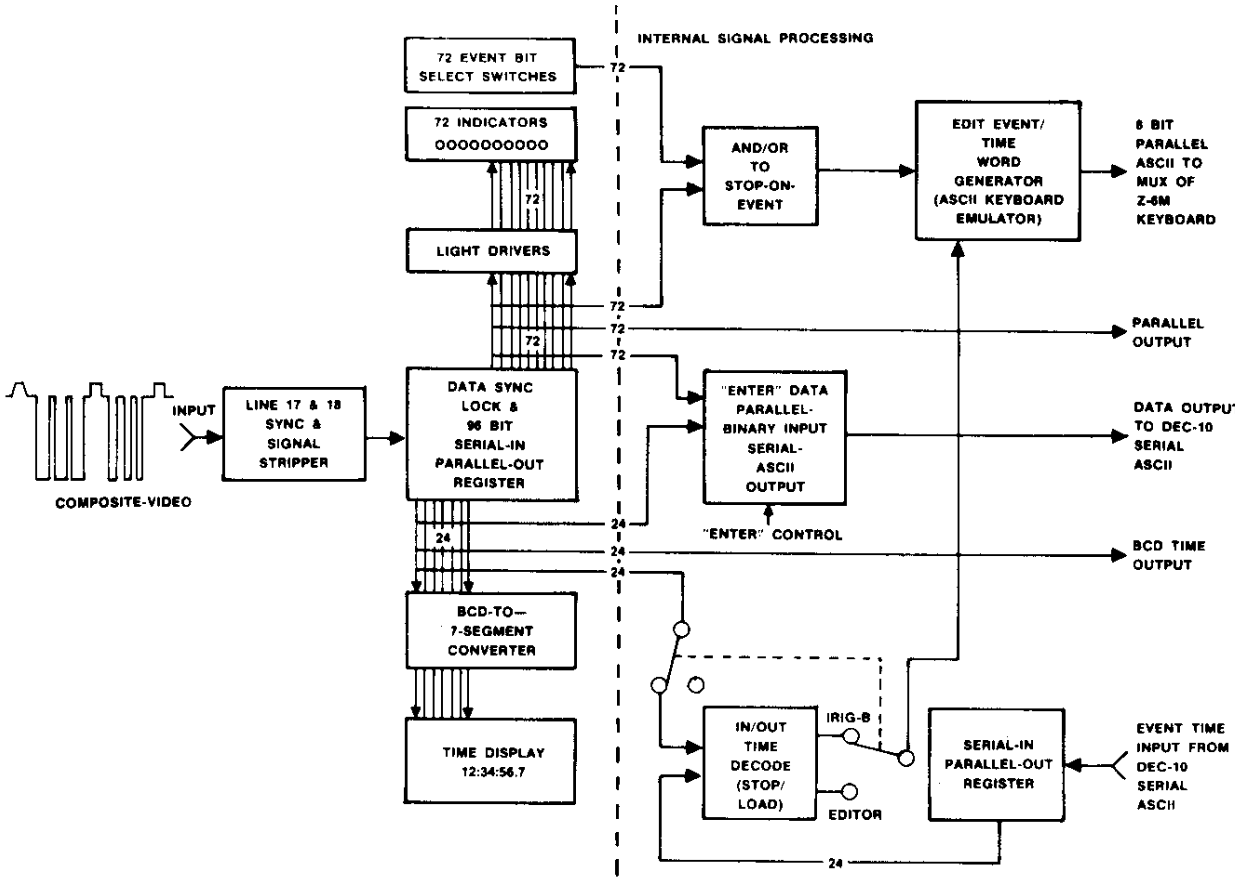


**Figure 4.  VIDRU Functional Block Diagram**