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Test and Evaluation

**TIME DIVISION MULTIPLEXED DATA
INFORMATION REQUIRED FOR EASTERN
RANGE TELEMETRY SUPPORT**

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction prescribes the format and lead times for the Range Users submission of telemetry (TLM) Time Division Multiplexed (TDM) data. The format and lead times are necessary for the Eastern Range (ER) to prepare, verify and distribute required software and firmware. It applies to all Range users at the ER, to all personnel associated with or assigned to the ER, and to all contractors and subcontractors on the ER needing or providing TDM data.

SUMMARY OF REVISIONS

This publication deletes obsolete Pulse Amplitude Modulation and Pulse Duration Modulation formats and clarifies lead times for the Range Users submission of TDM format data. A bar (|) indicates a revision from the previous edition.

1. Terms Explained. For the purpose of this instruction the following terms apply:

1.1. **Range User.** Any DoD organization, other US government agency, state or local government; civic, private, or commercial organization; or foreign government program approved by the 45 SW Commander or designated representative, to use range facilities or resources.

1.2. **Program.** A system test, operation, or other activity conducted by a Range User on the ER or requiring ER support.

2. Duties and Responsibilities.

2.1. The Program Support Manager (PSM), 1 Range Operations Squadron (1 ROPS), will determine if a meeting between the Range User and ER personnel is necessary to resolve any discrepancies between the Range User's requirements and ER capabilities and further, to avoid any misconceptions or misinterpretations. This meeting should be held a minimum of ten months prior to the first sched-

uled use of the TLM time division multiplexed data and will be called and chaired by the PSM and supported by appropriate wing personnel.

2.2. The Range User will provide the telemetry format information described in the following attachments (including computer entry tape formatting and data reduction needs) in the Program Requirements Document (PRD); or in a separate document or documents referred to in the PRD. Refer to the manuals applicable to the PRD for instructions concerning the information required and the specified lead times, as well as to the information and lead times contained in this instruction.

2.3. Range Users will, in combination with the requirements in paragraph 2.2., be prepared to discuss the operations of their internal guidance systems and the manner in which their data is processed and telemetered. The Eastern Range uses this data to compute the instantaneous position and predicted impact point of the flight hardware and to display them in real time for the Mission Flight Control Officer (MFCO).

2.4. The 45 Range Management Squadron (45 RMS) will manage range operation and maintenance contract or range system support issues as agreed to between the Range User and the PSM. RMS will appoint project personnel as required to initiate, monitor, and verify modifications or enhancements to range contracts and/or range systems to meet validated Range User requirements.

3. Procedures. The ER telemetry data format information requirements for TDM data are shown in **Attachment 1**. The Range User must uniquely identify each parameter within the TDM format. The range user must supply six copies of the format document and two copies of serial magnetic tapes or digital recording in Eastern Range compatible format to 1 ROPS.

3.1. **Data Submission Timelines.** The time required for TDM format submission depends on program requirements. New range users or programs requiring range modification must supply TDM format documentation with the PRD. The PRD timeline enables depot level acquisition and test of TLM resources supporting Range User requirements. Existing programs having minor operation and maintenance format changes must supply TDM format documentation at least 210 working days prior to first scheduled use of range telemetry systems. Programs having TDM format changes affecting only Decommutators must supply TDM documentation at least 90 working days prior to first scheduled use.

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Vice Commander

Attachment 1

ER TELEMETRY FORMAT INFORMATION REQUIREMENTS FOR TDM DATA

A1.1. General. The following apply to all TDM data:

A1.1.1. **Format description.** A complete graph, wheel, or chart description must be provided. In addition, a written description is desired.

A1.1.2. **Magnetic Tape or Digital Recording.** A serial magnetic tape or digital recording containing a true sample of the formats to be decommutated is required. A magnetic tape with unique, non-zero data values in each analog channel is required; dynamic values which actually simulate true launch values is preferred. Discrete measurements should transition as they would during an actual launch.

A1.1.3. **Transmission Peculiarities.** For example, identify each interruption or recycle of the format.

A1.1.4. **Dynamic Format Changes.** For example, identify each change from one format to another and each dynamic change in the given format.

A1.1.5. **Data Translation.** Specify any computer formatter tape requirements and real time retransmission requirements.

A1.1.6. **Calibrations required:** Pre- and post-mission.

A1.2. Detailed Format Description.

A1.2.1. **PCM.** Data is expected to conform with all standards specified in IRIG 106-XX, chapter 4. Complete format information for decommutation purposes includes:

A1.2.1.1. Bit rate, associated bit rate stability, and bit rate changes during test.

A1.2.1.2. Bit Jitter.

A1.2.1.3. Type code - NRZ-L, NRZ-S, Bi-phase, etc., ([Attachment 2](#)).

A1.2.1.4. Sync patterns and location of each:

A1.2.1.4.1. Words and fragmented words (if any).

A1.2.1.4.2. Mainframe.

A1.2.1.4.3. Subframe.

A1.2.1.4.4. Sub-subframe.

A1.2.1.4.5. Multi-commutation frame.

A1.2.1.4.6. Any change in sync patterns during test.

A1.2.1.4.7. Maximum count and reset count for incrementing sync patterns.

A1.2.1.5. Bits per word.

A1.2.1.6. Words per frame.

A1.2.1.7. Words per subframe and location of each in the mainframe or subframe respectively.

A1.2.1.8. Multi-commutation (cross-strapping).

A1.2.1.9. Ratio of subframe and sub-subframe cycle and whether they are synchronous or asynchronous.

A1.2.1.10. Data parity.

A1.2.1.11. In groups of bi-level bits, identify how the bits are numbered relative to their order of transmission. For example, in an eight-bit bi-level word, are the bits numbered 1 through 8, 8 through 1, 0 through 7, 7 through 0, etc.

A1.2.1.12. Bit significance. A description of the method by which a single data sample is encoded into a series of bits. Detailed information regarding noise immunity schemes (such as parity, etc.) must be included.

A1.2.1.13. MSB or LSB transmitted first for real time.

A1.2.1.14. MSB or LSB transmitted first for dump.

A1.2.1.15. A copy of a pre-detected or FM magnetic tape recording or digital recording of the actual formats to be decommutated. Information accompanying the tape will contain the following as a minimum; carrier frequency, tape speed, channel location and appropriate program/test identifiers.

A1.2.1.16. Polarity of RZ, NRZ-L or bi-phase-L signal. Example: Higher carrier or subcarrier limit = binary one. Lower carrier or subcarrier limit = binary zero.

A1.2.2. **Other.** Other types of TDM data should be supplied with information using the preceding description as a guide.

A1.3. Computer Formatted Tapes System Requirements.

A1.3.1. Detailed TDM format description as outlined in paragraph [A1.2.](#)

A1.3.2. A detailed description of the computer entry tape containing the following:

A1.3.2.1. Definition of the time word format.

A1.3.2.1.1. Code format - binary, BCD, etc.

A1.3.2.1.2. Position definition of time bits in time words.

A1.3.2.1.3. Number and position of time words in record.

A1.3.2.2. Definition of data word format.

A1.3.2.2.1. Data type - RAW PCM, ASCII Encoded, etc.

A1.3.2.2.2. Position definition of data bits in data word.

A1.3.2.2.3. Number of data words per frame.

A1.3.2.2.4. Number of frames per record.

A1.3.2.3. Definition of unique words format.

A1.3.2.3.1. Content description - status bits, flag bits, ID bits, etc.

A1.3.2.3.2. Position definition of bits in unique word.

A1.3.2.3.3. Number and position of unique words in record.

A1.3.2.4. Total words or bytes per record.

A1.3.2.5. Number of records per file.

A1.3.2.6. Number of files per computer tape.

A1.3.2.7. Deletion or inclusion of data during decommutator out-of-sync. If inclusion, does truncation from return to sync produce?

A1.3.2.7.1. A fixed length record? A variable length record?

A1.3.2.7.2. Description of data editing requirements.

A1.3.2.8. Computer tape bit packing densities of 800, 1600 and 6250 bits per inch are available.

A1.3.2.9. IBM or DEC Mode selection for first byte to tape.

A1.3.2.10. Definition of computer entry tape labeling requirements.

A1.3.2.11. Delivery schedule to ensure optimum programming concept development.

A1.3.3. If off-range raw data tapes are to be formatted by the ER, a complete description of tape content (track definition, time code used, etc.) must be furnished and the tape be compatible with ER facilities.

A1.3.4. What tape labeling information is required? Example: Reel number, start and stop times, raw data source, link identification, etc.

A1.4. Real Time Retransmission Requirements - Edited Data (Range Safety and Range User).

A1.4.1. Bit rate of transmitted data.

A1.4.2. Extracted parameters selected, including measurement numbers and/or word, frame and channel locations.

A1.4.3. Sample rates per parameters.

A1.4.4. Parameter priority.

A1.4.5. Time word requirements.

A1.4.5.1. Code format - binary, BCD, etc.

A1.4.5.2. Position definition of time bits in time words.

A1.4.5.3. Number and position of time words in retransmission frame.

A1.4.6. Unique word requirements.

A1.4.6.1. Content description - status bits, flag bits, ID bits, etc.

A1.4.6.2. Position definition of bits in unique words.

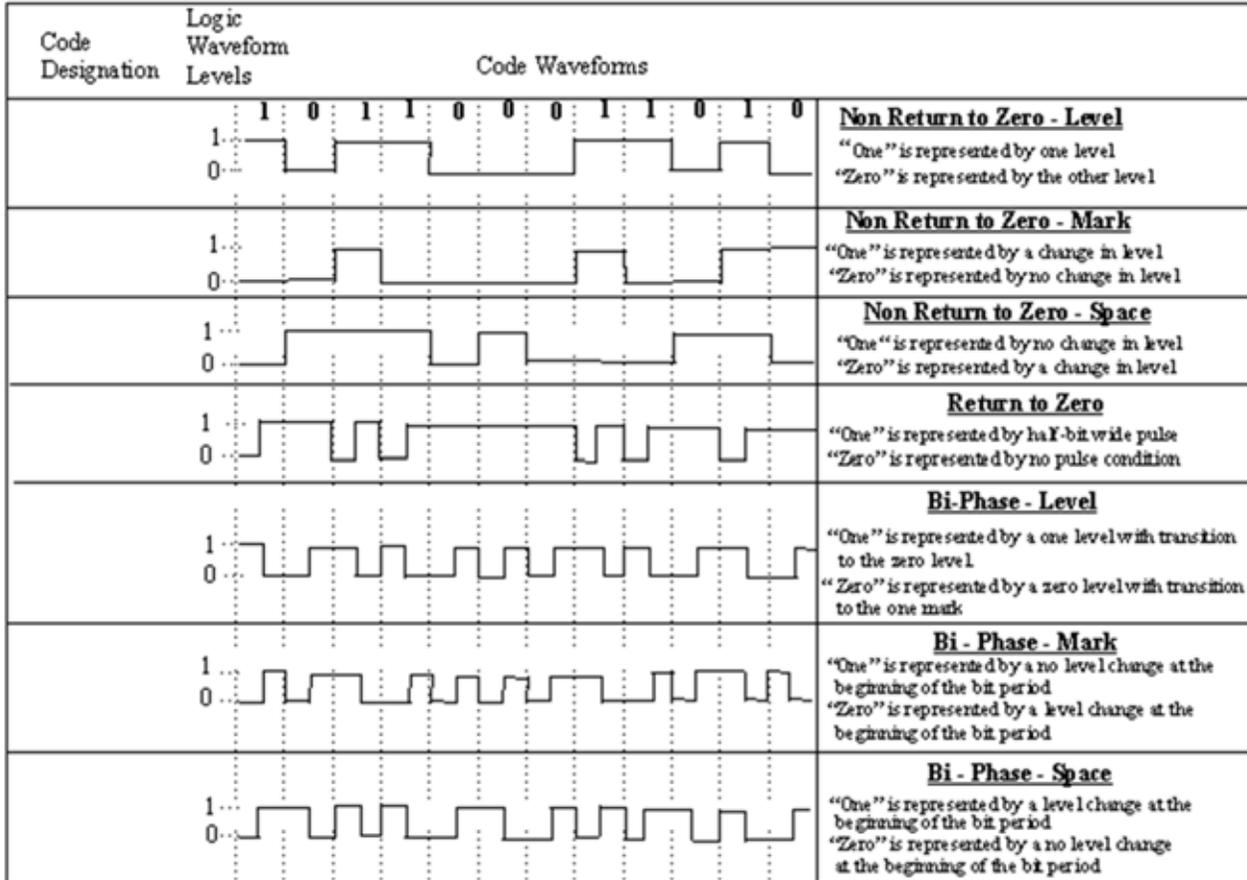
A1.4.6.3. Number and position of unique words in retransmission.

A1.4.7. Check sum requirements.

Attachment 2

PCM WAVEFORMS

Figure A2.1. PCM Waveforms.



Attachment 3

ER GUIDANCE INFORMATION REQUIREMENTS

A3.1. General. The following information is required as a prerequisite to software development and modification. Because each guidance system is unique, the requirements listed in this attachment are guidelines to help the range user prepare for meeting the requirements in the basic instruction.

A3.2. Details.

A3.2.1. Bit weights, register sizes, floating or fixed point number systems, scale factors, etc.

A3.2.2. Algorithms needed to convert the vehicle guidance coordinate system to the Earth-fixed EFG system used at the Eastern Range in which E is positive through Greenwich Meridian, G is positive through the North Pole and F completes a right-handed coordinate system. The algorithms must account for the need to use telemetered guidance times, and define whether or not they are homogeneous with the vectors. They must take into account the Earth model used, the reference spheroid, etc.

A3.2.3. Define the delays associated with time-tagging; i.e., time is initially at some value and begins to increment some specific time before or after the guidance system goes inertial.

A3.2.4. Define the alignment of the vehicle coordinate system axes relative to the launch complex.

A3.2.5. Provide a magnetic tape or digital recording containing the telemetered guidance data interlaced, as on launch day, with other telemetry information. On this tape, the guidance system must be made to go inertial, and the inertial conditions provided in an accompanying description. This tape is required as a consequence of early testing of the guidance interface with the telemetry system. In addition, the Eastern Range must be notified of all tests conducted on the launch complex in which the guidance system is commanded to the inertial mode, so the range may make a magnetic tape of the resulting telemetry data. This last minute tape will serve as a final validation of our configuration and is not a substitute for the earlier tape.

Figure A3.1. ER Guidance Information Requirements.

