



AEROSPACE STANDARD	AS15532™	REV. A
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Data Word and Message Formats		

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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FOREWORD

This document was developed as a supplemental standard to SAE AS15531, Digital Time Division Command/Response Multiplex Data Bus. This standard is the result of a conversion of a military document to a commercial standard. The lineage of this document is:

Chapter 11, MIL-HDBK-1553, Multiplex Applications Handbook
Section 80, MIL-HDBK-1553A, Multiplex Applications Handbook.

These documents were originally prepared under the SAE AS-1A Avionics Integration Subcommittee.

This document should be used as an aid to the development of data word and message formats for use in 16-bit data bus architectures. This document is applicable to both MIL-STD-1553B and SAE AS15531, and as such, references made internal to this document are shown as 15531/1553 to show when applicable.

This document has been updated from the previous Section 80 of MIL-HDBK-1553A as a result of suggestions and corrections recommended by users. Additionally, editorial changes and clarifying notes have been added throughout the document.

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1. SCOPE:

The emphasis in this standard is the development of data word and message formats for AS15531 or MIL-STD-1553 data bus applications. This standard is intended as a guide for the designer to identify standard data words and messages for use in avionics systems and subsystems. These standard words and messages, as well as the documentation format for interface control document (ICD) sheets, provide the basis for defining 15531/1553 systems. Also provided in this standard is the method for developing additional data word formats and messages that may be required by a particular system but are not covered by the formats provided herein. It is essential that any new word formats or message formats that are developed for a 15531/1553 application follow the fundamental guidelines established in this standard in order to ease future standardization of these words and messages. The standard word formats presented represent a composite result of studies conducted by the U.S. Army, Navy, and Air Force (see References 1, 2 and 3, respectively).

1.1 References:

1. MIL-STD-1553 Data Word Standardization Technical Report, STR- DD-81273-1, SEMCOR, September 1981, U.S. Army Avionics R&D Activity, Contract No. DAAK80-79-C-0258.
2. AAAS Multiplex Armament Data Word Standardization Study, 4092 TM-81 BASIC -006, SEMCOR, February 1981, Naval Air Development Center, Contract No. N62269-78-C-0302.
3. MIL-STD-1553 Multiplex Data Bus Word Format Study, Boeing Military Airplane Company, October 1981, USAF/ASD Contract No. F33615-80-C-0124.

In accordance with Public Law 94-168, Metric Conversion Act of 1975, and Department of Defense (DOD) Directive 4120.18, Use of Metric System of Measurement, metric units are preferred for use in new systems. (Reference National Aerospace Standard NAS10001, Preferred Metric Units for Aerospace, which lists the preferred metric units and conversion factors for a number of commonly used quantities in the aerospace industry.) However, when the use of metric units is not practical, the English units presented in this document may be used.

The necessity for standardizing data word and message formats became evident as more and more subsystems provided 15531/1553 interfaces as the basic input and output communication interface. Without coordination of these interfaces, outputs from a subsystem were incompatible with the input requirements of the interfacing subsystem. When new 15531/1553 hardware and systems are designed, the system designer is responsible for identifying the interface requirements of all devices and establishing compatible words and messages for proper communications. Naturally, this is accomplished during the early system development phases and is then reflected in future procurement specifications for the subsystem elements of the design. This method provides an integrated system that meets all the individual communication requirements. However, as more 15531/1553 systems are developed, this approach may result in subsystems that are incapable of exchanging data because of word and message formatting differences, even though the units meet all the requirements of 15531/1553 and their individual procurement specifications. In this case, the system designer is faced with the choice of using additional processing equipment to translate words and messages from one subsystem to another or modifying the off-the-shelf hardware to achieve integration.

1.1 (Continued):

Usually the job of data manipulation falls on the bus controller-processor. Messages from each subsystem must be transmitted to the bus controller (RT to bus controller), which constructs new words with the appropriate engineering units, scaling, encoding, bit positions, etc., before retransmission (bus controller to RT) to the subsystem requiring the data. Word order is another message inconsistency that must be resolved. The solution to this problem does not lie in bus controller manipulation or in subsystem modifications; it lies in establishing common usage word formats and common usage output message formats to provide a subsystem designer the information required to build compatible communication interfaces.

This standard is subdivided to allow easy access when selecting the appropriate word or message format from the standards available. For signals that do not fit the standard word formats available, guidelines are provided for establishing the appropriate word format. Common signal naming practices and an ICD presentation format are provided. Some of the key benefits gained by use of the principles presented in this standard will be (1) subsystem word format definition, (2) common signal naming practices, and (3) standardization of ICD format across programs. The guidelines required for developing message formats and an ICD presentation format are also provided.

2. WORD FORMATS:

A word format is the structure, order, and value represented by the bits in a signal data transmission. To properly define a data word format requires knowledge concerning the signal, the 15531/1553 application, and the coding technique used to communicate the information. All of these elements are discussed in the following paragraphs.

The general rules for 15531/1553 word construction (paragraph 2.2) apply to all data words whether standard or nonstandard. These rules are to be followed in the development of words that do not fit the formats listed in the standard word tables (paragraph 2.5). The procedures on how to construct a data word format described in paragraph 2.3 also apply to any data word whether or not it is eventually determined to fit a standard format. Paragraph 2.1 describes the standardized ICD presentation format that should be used for all 15531/1553 words.

2.1 Interface Control Document Signal Presentation Format:

The ICD format required for the documentation of all words in a 15531/1553 system is shown in Tables I and II. Presentation formats are provided for single word (Table I) and double precision (Table II). Signals that require more than two words should use the single word format with the number of words indicated in the REMARKS section (e.g., "3 word quantity-word 1 of 3") of the word format presentation sheet. The ICD presentation sheet entries are discussed in the following paragraph.

TABLE I - Presentation Format, Single Word

WORD NAME :	DOC. NO.	REV.
	DATE	
	SHEET 1 OF	
WORD ID :	MAX VALUE :	
SOURCE(S) :	MIN VALUE :	
DEST(S) :	RESOLUTION :	
COMP RATE :	ACCURACY :	
XMIT RATE :	MSB :	
SIGNAL TYPE :	LSB :	
UNITS :	FULLSCALE :	

FIELD NAME	BIT NO.	DESCRIPTION
	-00-	
	-01-	
	-02-	
	-03-	
	-04-	
	-05-	
	-06-	
	-07-	
	-08-	
	-09-	
	-10-	
	-11-	
	-12-	
	-13-	
	-14-	
	-15-	

REMARKS:

See notes to Tables I and II

TABLE II - Presentation Format, Double Precision

DOC. NO.
DATE
SHEET 1 OF

REV.

WORD NAME :

WORD ID :
SOURCE(S) :
DEST(S) :
COMP RATE :
XMIT RATE :
SIGNAL TYPE :
UNITS :

MAX VALUE :
MIN VALUE :
RESOLUTION :
ACCURACY :
MSB :
LSB :
FULLSCALE :

FIELD NAME	BIT NO.	DESCRIPTION
MSW	-00-	
	-01-	
	-02-	
	-03-	
	-04-	
	-05-	
	-06-	
	-07-	
	-08-	
	-09-	
	-10-	
	-11-	
	-12-	
	-13-	
	-14-	
	-15-	
LSW	-00-	
	-01-	
	-02-	
	-03-	
	-04-	
	-05-	
	-06-	
	-07-	
	-08-	
	-09-	
	-10-	
	-11-	
	-12-	
	-13-	
	-14-	
	-15-	

REMARKS:

See notes to Tables I and II.

Notes to Tables I and II:

Tables I and II are the skeleton ICD sheets. Figures 1 and 2 provide the detailed layout for the ICD presentation sheets. The definition of each entry is as follows:

DOC. NO.:	The interface control document number.
REV.:	The revision symbol for this sheet.
DATE:	The calendar date of the latest revision to this sheet.
SHEET 1 OF ##:	This sheet count allows multiple sheets.
WORD NAME:	The formal name selected for this word as described in paragraph 2.4, Naming.
WORD ID:	Code identifying the message of which this word is part. The WORD ID is constructed as follows:

XXXXSX-YYYYSY-W# or XXXXSX-YYYYSY-W#/W#, where:

XXXX = Transmitting terminal name (see Table III for examples). Transmitting terminal has T/R bit = 1.

SX = Transmitting terminal 15531/1553 subaddress from which the word originated.

YYYY = Receiving terminal name (see TABLE III for examples). Receiving terminal has T/R bit = 0.

SY = Receiving terminal 15531/1553 subaddress to which the word is addressed.

W# = Word number of single word.

W#/W# = Word numbers of double word (i.e. 12/13).

Note that the XXXXSX-YYYYSY section of the Word ID is the Message ID. The rules for Message ID construction are:

Entries in XXXX and YYYY are four characters left-justified with trailing blanks (such as "INS1", "SMS ", "MC "). In the broadcast mode of operation, YYYY is "ALL ".

Notes to Tables I and II (continued):

Entries in SX and SY are two numeric characters with a range of 01-30 or the characters BC, M0, or M1. The latter characters are used in conjunction with the bus controller and the transmission of 15531/1553 mode codes. M0 represents the transmission of 00000 in the subaddress/mode field of the 15531/1553 command word; M1 represents the transmission of 11111 in that field.

When M0 and M1 are used as either SX or SY, the numeric entry, used in conjunction with the receive/ transmit terminal, will indicate the 15531/1553 mode code (the data word count/mode code field of the 15531/1553 command word). For example, the word ID INS 03-BC1 M0-MCCW indicates that a Mode Command Without Data Word (MCCW), is being commanded by the bus controller (BC1), using 00000 (M0) as the subaddress/mode, to the INS. The mode code being transmitted is Initiate Self Test (03)(See Tables LXVI through LXVIII for the relationship between mode codes and word/message ID formats).

Entries in W# are two numeric characters with a range of 01-32. The field W#/W# is a five- character field. If the word is single precision, the last three characters will be blank. In the case of command words, this field will contain:

RCW - BC-to-RT Transfer
TCW - RT-to-BC Transfer
RTCW - RT-to-RT Transfer
MCCW - Mode Command Without Data Word
MCCDT - Mode Command With Data Word (Transmit)
MCCDR - Mode Command With Data Word (Receive)
BCCW - BC-to-RT Transfer, Broadcast
BCCRT - RT-to-RT Transfer, Broadcast
BCMC - Mode Command Without Data Word, Broadcast
BCMCD - Mode Command With Data Word, Broadcast

In the case of status words, this field will contain:

TSW - Transmit Status Word
RSW - Receive Status Word

Examples of typical WORD ID's are shown in Table IV.

Notes to Tables I and II (continued):

SOURCE(S): Name(s) of the subsystem(s) originating the word, usually abbreviated or an acronym. When a word is modified by a subsystem, that subsystem becomes the originating source. Source information is used to allow tracking of data from the originating source to all destinations.

DEST(S): Name(s) of the subsystem(s) that will receive the word, usually abbreviated or an acronym. Destination information is used to allow tracking of data back to the originating source and to other destinations.

COMP RATE: The rate in times per second (Hz) that the data is computed.

XMIT RATE: The nominal rate in times per second (Hz) that the message is transmitted.

SIGNAL TYPE: 2's complement -- A representation of a signed value where the negative codes are generated by adding one to the complement of the number. The use of 2's complement in a digital computer facilitates the subtraction process.

Unsigned numeric -- A binary representation of an unsigned value. The value may be an integer or may have a fractional component.

Discrete -- A single binary bit whose state of one or zero has a specified meaning.

Coded -- A grouping of bits in which the pattern of ones and zeros has a specified meaning.

Binary Coded Decimal(BCD) -- The natural binary coded decimal (NBCD) or four-bit (8421) code is a special BCD form. The NBCD code allows only 10 (0-9) valid states, with the values 10-15 being invalid.

ASCII -- A seven-bit binary code representing alpha and numeric characters.

ASCII-8 -- Extended ASCII using eight bits for additional character representations (show Signal Type as "ASCII").

Notes to Tables I and II (continued):

UNITS:	The engineering units of the transmitted signal. Note: Some words may be unitless, wherein the text in the UNITS field should be left blank or shown as "N/A".
MAX VALUE:	The maximum value that the signal, as supplied by the subsystem, can attain. MAX VALUE must be less than or equal to FULLSCALE.*
MIN VALUE:	The minimum value that the signal, as supplied by the subsystem, can attain.*
RESOLUTION:	Resolution is defined as the minimum detectable change in value of the signal, as supplied by the subsystem; its value should be expressed to the number of places necessary to achieve the required accuracy.*
ACCURACY:	The accuracy of the signal as supplied by the subsystem.*
MSB:	The value of the most significant bit of the word and/or field.*
LSB:	The value of the least significant bit of the word and/or field; its value should be expressed to the number of places necessary to achieve the required accuracy.*
FULLSCALE:	The maximum value the data field can attain (two times MSB minus LSB).*
FIELD NAME:	The formal name selected for a signal describing a bit, field, or single or double precision word.
BIT NO:	BIT No. is as defined in paragraph 2.2.1.
DESCRIPTION:	A functional description of the signal.
MSW:	Most significant word of a double precision signal.
LSW:	Least significant word of a double precision signal.
REMARKS:	(Optional) Additional comments, if needed, pertaining to the word.
PAGE:	Page No. of the ICD.

* = Set to N/A when a data word is divided into discrete, coded, or ASCII fields.

		COLUMN #														
		1	1	2	2	3	3	4	4	5	5	6	6	7	7	
		1	5	0	5	0	5	0	5	0	5	0	5	0	5	
		DOC. NO. 15 characters REV. XX														1
		DATE 27 characters														2
		SHEET XX OF XX														3
WORD NAME :	60 characters per line															4
WORD ID :																5
SOURCE(S) :	MAX VALUE :															6
DEST(S) :	MIN VALUE :															7
COMP RATE :	RESOLUTION :															8
XMIT RATE :	ACCURACY :															9
SIGNAL TYPE :	MSB :															10
UNITS :	LSB :															11
	FULLSCALE :															12
FIELD NAME		BIT NO.		DESCRIPTION												13
17 characters per line		-00-N		40 characters per line												14
		-01-N														15
		-02-N														16
		-03-N														17
		-04-N														18
		-05-N														19
		-06-N														20
		-07-N														21
		-08-N														22
		-09-N														23
		-10-N														24
		-11-N														25
		-12-N														26
		-13-N														27
		-14-N														28
		-15-N														29
Remarks:																30
75 characters per line																31
																32
																33
																34
																35
																36
																37
																38
																39
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																57
																58

FIGURE 1 - ICD Presentation Sheet, Single Word (Sheet 1 of 4)

SPACING - SINGLE DATA WORD ICD PRESENTATION SHEET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Word ID	6	16-45	30
Max Value	6	62-75	14
Source	7	16-45	30
Min Value	7	62-75	14
Destination	8	16-45	30
Resolution	8	62-75	14
Comp Rate	9	16-45	30
Accuracy	9	62-75	14
Xmit Rate	10	16-45	30
MSB	10	62-75	14
Signal Type	11	16-45	30
LSB	11	62-75	14
Units	12	16-45	30
Fullscale	12	62-75	14
Field Name	16-17	1-17	17/line
Bit Indicator	16	28	1
Description	16-17	36-75	40/line
Field Name	18-19	1-17	17/line
Bit Indicator	18	28	1
Description	18-19	36-75	40/line
Field Name	20-21	1-17	17/line
Bit Indicator	20	28	1
Description	20-21	36-75	40/line
Field Name	22-23	1-17	17/line
Bit Indicator	22	28	1
Description	22-23	36-75	40/line
Field Name	24-25	1-17	17/line
Bit Indicator	24	28	1
Description	24-25	36-75	40/line
Field Name	26-27	1-17	17/line
Bit Indicator	26	28	1
Description	26-27	36-75	40/line
Field Name	28-29	1-17	17/line
Bit Indicator	28	28	1
Description	28-29	36-75	40/line
Field Name	30-31	1-17	17/line
Bit Indicator	30	28	1
Description	30-31	36-75	40/line
Field Name	32-33	1-17	17/line
Bit Indicator	32	28	1
Description	32-33	36-75	40/line
Field Name	34-35	1-17	17/line
Bit Indicator	34	28	1
Description	34-35	36-75	40/line
Field Name	36-37	1-17	17/line
Bit Indicator	36	28	1
Description	36-37	36-75	40/line
Field Name	38-39	1-17	17/line
Bit Indicator	38	28	1
Description	38-39	36-75	40/line
Field Name	40-41	1-17	17/line
Bit Indicator	40	28	1
Description	40-41	36-75	40/line
Field Name	42-43	1-17	17/line
Bit Indicator	42	28	1
Description	42-43	36-75	40/line
Field Name	44-45	1-17	17/line
Bit Indicator	44	28	1
Description	44-45	36-75	40/line
Field Name	46-47	1-17	17/line
Bit Indicator	46	28	1
Description	46-47	36-75	40/line
Remarks	49-56	1-75	75/line
Page	58		

FIGURE 1 - ICD Presentation Sheet, Single Word (Sheet 2 of 4)



SPACING - SINGLE COMMAND/STATUS WORD ICD PRESENTATION SHHET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Word ID	6	16-45	30
Xmit Rate	7	16-45	30
Field Name	12-13	1-17	17/line
Bit Indicator	12	28	1
Description	12-13	36-75	40/line
Field Name	14-15	1-17	17/line
Bit Indicator	14	28	1
Description	14-15	36-75	40/line
Field Name	16-17	1-17	17/line
Bit Indicator	16	28	1
Description	16-17	36-75	40/line
Field Name	18-19	1-17	17/line
Bit Indicator	18	28	1
Description	18-19	36-75	40/line
Field Name	20-21	1-17	17/line
Bit Indicator	20	28	1
Description	20-21	36-75	40/line
Field Name	22-23	1-17	17/line
Bit Indicator	22	28	1
Description	22-23	36-75	40/line
Field Name	24-25	1-17	17/line
Bit Indicator	24	28	1
Description	24-25	36-75	40/line
Field Name	26-27	1-17	17/line
Bit Indicator	26	28	1
Description	26-27	36-75	40/line
Field Name	28-29	1-17	17/line
Bit Indicator	28	28	1
Description	28-29	36-75	40/line
Field Name	30-31	1-17	17/line
Bit Indicator	30	28	1
Description	30-31	36-75	40/line
Field Name	32-33	1-17	17/line
Bit Indicator	32	28	1
Description	32-33	36-75	40/line
Field Name	34-35	1-17	17/line
Bit Indicator	34	28	1
Description	34-35	36-75	40/line
Field Name	36-37	1-17	17/line
Bit Indicator	36	28	1
Description	36-37	36-75	40/line
Field Name	38-39	1-17	17/line
Bit Indicator	38	28	1
Description	38-39	36-75	40/line
Field Name	40-41	1-17	17/line
Bit Indicator	40	28	1
Description	40-41	36-75	40/line
Field Name	42-43	1-17	17/line
Bit Indicator	42	28	1
Description	42-43	36-75	40/line
Remarks	44-56	1-75	75/line
Page	58		

FIGURE 1 - ICD Presentation Sheet, Single Word (Sheet 3 of 4)

SPACING - WORD CONTINUATION ICD PRESENTATION SHEET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Remarks	7-56	1-75	75/line
Page	58		

FIGURE 1 - ICD Presentation Sheet, Single Word (Sheet 4 of 4)

	1	5	1	1	2	2	3	3	4	4	5	5	6	6	7	7
	1	5	0	5	0	5	0	5	0	5	0	5	0	5	0	5
DOC. NO.											15 characters				REV.	XX
DATE											27 characters					
SHEET											XX OF XX					
WORD NAME	60 characters per line															
WORD ID																
SOURCE(S)																
DEST(S)	30 characters per line															
COMP RATE																
XMIT RATE																
SIGNAL TYPE																
UNITS																
MAX VALUE																
MIN VALUE																
RESOLUTION	14 characters															
ACCURACY	per line															
MSB																
LSB																
FULLSCALE																
FIELD NAME	BIT NO.															
DESCRIPTION																
MSW -00-N																
-01-N																
-02-N																
-03-N																
-04-N																
-05-N																
-06-N																
-07-N																
-08-N																
-09-N																
-10-N																
-11-N																
-12-N																
-13-N																
-14-N																
-15-N																
LSW -00-N																
-01-N																
-02-N																
-03-N																
-04-N																
-05-N																
-06-N																
-07-N																
-08-N																
-09-N																
-10-N																
-11-N																
-12-N																
-13-N																
-14-N																
-15-N																
40 characters per line																
17 characters per line																
Remarks:																
75 characters per line																

(PAGE)

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 1 of 6)

SPACING - DOUBLE DATA WORD ICD PRESENTATION SHEET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Word ID	6	16-45	30
Max Value	6	62-75	14
Source	7	16-45	30
Min Value	7	62-75	14
Destination	8	16-45	30
Resolution	8	62-75	14
Comp Rate	9	16-45	30
Accuracy	9	62-75	14
Xmit Rate	10	16-45	30
MSB	10	62-75	14
Signal Type	11	16-45	30
LSB	11	62-75	14
Units	12	16-45	30
Fullscale	12	62-75	14
Field Name	16	1-17	17/line
Bit Indicator	16	28	1
Description	16	36-75	40/line
Field Name	17	1-17	17/line
Bit Indicator	17	28	1
Description	17	36-75	40/line
Field Name	18	1-17	17/line
Bit Indicator	18	28	1
Description	18	36-75	40/line
Field Name	19	1-17	17/line
Bit Indicator	19	28	1
Description	19	36-75	40/line
Field Name	20	1-17	17/line
Bit Indicator	20	28	1
Description	20	36-75	40/line
Field Name	21	1-17	17/line
Bit Indicator	21	28	1
Description	21	36-75	40/line
Field Name	22	1-17	17/line
Bit Indicator	22	28	1
Description	22	36-75	40/line
Field Name	23	1-17	17/line
Bit Indicator	23	28	1
Description	23	36-75	40/line
Field Name	24	1-17	17/line
Bit Indicator	24	28	1
Description	24	36-75	40/line
Field Name	25	1-17	17/line
Bit Indicator	25	28	1
Description	25	36-75	40/line
Field Name	26	1-17	17/line
Bit Indicator	26	28	1
Description	26	36-75	40/line
Field Name	27	1-17	17/line
Bit Indicator	27	28	1
Description	27	36-75	40/line
Field Name	28	1-17	17/line
Bit Indicator	28	28	1
Description	28	36-75	40/line
Field Name	29	1-17	17/line
Bit Indicator	29	28	1
Description	29	36-75	40/line
Field Name	30	1-17	17/line
Bit Indicator	30	28	1
Description	30	36-75	40/line
Field Name	31	1-17	17/line
Bit Indicator	31	28	1
Description	31	36-75	40/line

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 2 of 6)

SPACING - DOUBLE DATA WORD ICD PRESENTATION SHEET (cont)			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Field Name	32	1-17	17/line
Bit Indicator	32	28	1
Description	32	36-75	40/line
Field Name	33	1-17	17/line
Bit Indicator	33	28	1
Description	33	36-75	40/line
Field Name	34	1-17	17/line
Bit Indicator	34	28	1
Description	34	36-75	40/line
Field Name	35	1-17	17/line
Bit Indicator	35	28	1
Description	35	36-75	40/line
Field Name	36	1-17	17/line
Bit Indicator	36	28	1
Description	36	36-75	40/line
Field Name	37	1-17	17/line
Bit Indicator	37	28	1
Description	37	36-75	40/line
Field Name	38	1-17	17/line
Bit Indicator	38	28	1
Description	38	36-75	40/line
Field Name	39	1-17	17/line
Bit Indicator	39	28	1
Description	39	36-75	40/line
Field Name	40	1-17	17/line
Bit Indicator	40	28	1
Description	40	36-75	40/line
Field Name	41	1-17	17/line
Bit Indicator	41	28	1
Description	41	36-75	40/line
Field Name	42	1-17	17/line
Bit Indicator	42	28	1
Description	42	36-75	40/line
Field Name	43	1-17	17/line
Bit Indicator	43	28	1
Description	43	36-75	40/line
Field Name	44	1-17	17/line
Bit Indicator	44	28	1
Description	44	36-75	40/line
Field Name	45	1-17	17/line
Bit Indicator	45	28	1
Description	45	36-75	40/line
Field Name	46	1-17	17/line
Bit Indicator	46	28	1
Description	46	36-75	40/line
Field Name	47	1-17	17/line
Bit Indicator	47	28	1
Description	47	36-75	40/line
Field Name	48	1-17	17/line
Bit Indicator	48	28	1
Description	48	36-75	40/line
Remarks	50-56	1-75	75/line
Page	58		

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 3 of 6)

SPACING - DOUBLE COMMAND WORD ICD PRESENTATION SHEET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Word ID	6	16-45	30
Xmit Rate	7	16-45	30
Signal Type	8	16-45	30
Field Name	12	16-45	17
Bit Indicator	12	28	1
Description	12	36-75	40
Field Name	13	1-17	17
Bit Indicator	13	28	1
Description	13	36-75	40
Field Name	14	1-17	17
Bit Indicator	14	28	1
Description	14	36-75	40
Field Name	15	1-17	17
Bit Indicator	15	28	1
Description	15	36-75	40
Field Name	16	1-17	17
Bit Indicator	16	28	1
Description	16	36-75	40
Field Name	17	1-17	17
Bit Indicator	17	28	1
Description	17	36-75	40
Field Name	18	1-17	17
Bit Indicator	18	28	1
Description	18	36-75	40
Field Name	19	1-17	17
Bit Indicator	19	28	1
Description	19	36-75	40
Field Name	20	1-17	17
Bit Indicator	20	28	1
Description	20	36-75	40
Field Name	21	1-17	17
Bit Indicator	21	28	1
Description	21	36-75	40
Field Name	22	1-17	17
Bit Indicator	22	28	1
Description	22	36-75	40
Field Name	23	1-17	17
Bit Indicator	23	28	1
Description	23	36-75	40
Field Name	24	1-17	17
Bit Indicator	24	28	1
Description	24	36-75	40
Field Name	25	1-17	17
Bit Indicator	25	28	1
Description	25	36-75	40
Field Name	26	1-17	17
Bit Indicator	26	28	1
Description	26	36-75	40
Field Name	27	1-17	17
Bit Indicator	27	28	1
Description	27	36-75	40
Field Name	28	1-17	17
Bit Indicator	28	28	1
Description	28	36-75	40
Field Name	29	1-17	17
Bit Indicator	29	28	1
Description	29	36-75	40

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 4 of 6)

SPACING - DOUBLE COMMAND WORD ICD PRESENTATION SHEET (cont)			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Field Name	30	1-17	17
Bit Indicator	30	28	1
Description	30	36-75	40
Field Name	31	1-17	17
Bit Indicator	31	28	1
Description	31	36-75	40
Field Name	32	1-17	17
Bit Indicator	32	28	1
Description	32	36-75	40
Field Name	33	1-17	17
Bit Indicator	33	28	1
Description	33	36-75	40
Field Name	34	1-17	17
Bit Indicator	34	28	1
Description	34	36-75	40
Field Name	35	1-17	17
Bit Indicator	35	28	1
Description	35	36-75	40
Field Name	36	1-17	17
Bit Indicator	36	28	1
Description	36	36-75	40
Field Name	37	1-17	17
Bit Indicator	37	28	1
Description	37	36-75	40
Field Name	38	1-17	17
Bit Indicator	38	28	1
Description	38	36-75	40
Field Name	39	1-17	17
Bit Indicator	39	28	1
Description	39	36-75	40
Field Name	40	1-17	17
Bit Indicator	40	28	1
Description	40	36-75	40
Field Name	41	1-17	17
Bit Indicator	41	28	1
Description	41	36-75	40
Field Name	42	1-17	17
Bit Indicator	42	28	1
Description	42	36-75	40
Field Name	43	1-17	17
Bit Indicator	43	28	1
Description	43	36-75	40
Field Name	44	1-17	17
Bit Indicator	44	28	1
Description	44	36-75	40
Remarks	46-56	1-75	75/line
Page	58		

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 5 of 6)

SPACING - WORK CONTINUEATION ICD PRESENTATION SHEET			
FIELD NAME	ROW(S)	COLUMN(S)	NO. OF CHARS
Doc No.	1	52-66	15
Rev.	1	74-75	2
Date	2	49-75	27
Sheet #	3	49-50	2
Total Sheets	3	55-56	2
Word Name	4-5	16-75	60/line
Remarks	7-56	1-75	75/line
Page	58		

FIGURE 2 - ICD Presentation Sheet, Double Precision (Sheet 6 of 6)

TABLE III - Standard Terminal Acronyms for Use in Word ID's

ACRONYM

ADC Air Data Computer
 ADF Automatic Direction Finder
 ADI Attitude Direction Indicator
 AHRS Attitude Heading Reference System
 AIU Avionics Interface Unit
 ALS Automatic Landing System
 ASI Airspeed Indicator
 ATHS Airborne Target Handoff System
 AUXS Auxiliary Sensor
 BBC Backup Bus Controller
 BC Bus Controller
 BIU Bus Interface Unit
 CAS Control Actuation System
 CDU Control Display Unit
 CNI Communication, Navigation,
 Identification
 CPU Central Processing Unit
 DL Data Link
 DP Display Processor
 DME Distance Measuring Equipment
 DNC Doppler Navigation Computer
 DNS Doppler Navigation System
 DTU Data Transfer Unit
 DVS Doppler Velocity Sensor
 ECM Electronic Countermeasures
 EHF Extra High Frequency Radio
 FCC Fire Control Computer
 FCS Fire Control System
 FIR Flight Incident Recorder
 FLC Flight Control
 FLIR Forward Looking Infrared
 GPS Global Positioning System
 GS Glideslope
 HAS Hover Augmentation System
 HF High Frequency Radio
 HMD Helmet Mounted Display
 HSI Horizontal Situation Indicator
 HUD Head-Up Display
 HV Host Vehicle
 ICP Integrated Control Panel
 ICS Intercommunication System
 ICU Ignition Control Unit
 IFF Identification, Friend or Foe
 ILS Instrument Landing System
 IMU Inertial Measurement Unit
 INS Inertial Navigation System
 INU Inertial Navigation Unit
 JCU JTIDS Control Unit

ACRONYM

KY Crypto Unit
 LOC Localizer
 MB Marker Beacon
 MC Mission Computer
 MFD Multi-Function Display
 MIU Missile Interface Unit
 MMR Multi-Mode Receiver
 MMS Mast Mounted Sight
 MPD Multi-Purpose Display
 NPU Navigation Processing Unit
 OM Omega
 PCU Power Control Unit
 PIU PLRS Interface Unit
 PNVIS Pilot Night Vision System
 RAD Radar Altimeter
 RDR Radar
 RIU Radar Interface Unit
 RT Remote Terminal
 RTU Remote Terminal Unit
 RWR Radar Warning Receiver
 SAS Stability Augmentation
 System
 SCU Signal Converter Unit
 SG Symbol Generator
 SHVI Standard HV Interface
 SIU Stores Interface Unit
 SL Stores Logic
 SMS Stores Management System
 SS Stores Station
 SSHV Slave SHVI
 TADS Target Acquisition
 Designation System
 TCM TERCOM
 TCN TACAN
 TCS Tactical Camera System
 TM Telemetry
 TSC Time Sync Controller
 UHF Ultra High Frequency Radio
 VDI Vertical Direction
 Indicator
 VHF Very High Frequency Radio
 VOR VHF Omni-Directional
 Range Radio
 VSI Vertical Situation
 Indicator
 WCS Weapon Control System
 WIU Weapon Interface Unit
 WXR Weather Radar

TABLE IV - Word ID Examples

WORD ID	TRANSFER TYPE	DESCRIPTION
INS 03-FLIR02-07	RT-to-RT	INS is transmitting word number 07 from subaddress 03 to subaddress 02 of FLIR
AHRS03-MC BC-07	RT-to-BC	AHRS is transmitting word number 07 from subaddress 03 to the MC (which is the bus controller).
BC1 BC-HUD205-07/08	BC-to-RT	BC1 (the bus controller) is transmitting word number 07 and 08 to subaddress 05 of HUD2.
NPU BC-ALL 04-15	Broadcast	NPU (the bus controller) is transmitting word number 15 to subaddress 04 in the broadcast mode of operation.

2.2 General Rules for 15531/1553 Word Construction:

The general rules for constructing compatible word formats apply to the standard words listed in paragraph 2.5 and to those words that do not meet the requirements for the standardized format. The following paragraphs provide generalized rules for establishing the basic word structure.

- 2.2.1 Data Word/Bit Designation: Figure 3 shows the horizontal presentation of the 16-bit data field of the data word defined in 15531/1553. The data field bits are numbered 00 through 15, left to right, with bit 00 designated as the most significant bit (MSB) and bit 15 designated as the least significant bit (LSB). In conformance to the requirements of 15531/1553, the most significant bit (bit 00) is transmitted first on the data bus.

The MSB and LSB designations indicated here refer to the relative weighting of the entire 16 bits in a 2's complement representation of signal value. The MSB and LSB designations will also be employed to define the most significant and least significant bits of parameters requiring less than or more than 16 bits. There can also be more than one signal value in a data word, thus requiring multiple MSB's and LSB's within the data field. Discrete bits and binary codes are also used to represent characters or modes. Throughout this document the term "data word" will be used in reference to this 16-bit data field.

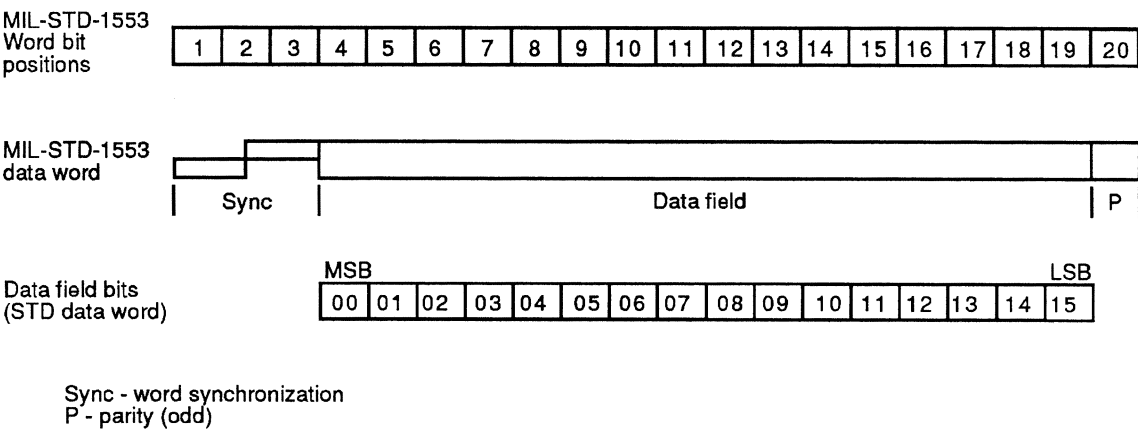


FIGURE 3 - Standard Data Word Bit Designation Related to Word Definition

2.2.2 Signal Coding and Placement: Several coding techniques are provided because of the variety of signal types that must be accommodated in a data word format. The following are the typical coding conventions and the presentation notations:

Data Type	Presentation Notation
a. 2's complement	Sign, MSB, LSB, and N (data bits)
b. Unsigned numeric	MSB, LSB, and N (data bits)
c. Discrete bit	D
d. Coded bits	MSB, LSB, and C (data bits)
e. Binary coded decimal (NBCD, 8421)	MSB, LSB, and B (data bits)
f. ASCII alphanumeric codes	MSB, LSB, and A (data bits)
g. Validity bit	V
h. Unused or reserved bits, logic 0	0
i. Logic 1	1
j. Floating point	MSB, LSB, Sign, & M (Mantissa) (data bits) MSB, LSB, Sign, & E (Exponent) (data bits)

2.2.2 (Continued):

Figure 4 shows some examples of typical word formats employing the above digital representations. The following general rules apply to all word structures:

- a. The MSB shall always be transmitted first, in accordance with 15531/1553.
- b. All spare or unused bits shall be transmitted as logic 0's, in accordance with 15531/1553.
- c. In the event that multiple precision quantities (information accuracy or resolution requiring more than 16 bits) are transmitted, the most significant bits shall be transmitted first, followed by the word(s) containing the less significant bits.
- d. The numerical value of the data should be represented using 2's complement notation. The value of the MSB should be an integer power of 2.
- e. Left justify; the sign, MSB, or first discrete (in that order of precedence) should appear in the left most (bit 00) position.
- f. No unused zero (0) bits should be placed in more significant bit positions than data. The exception to this rule is ASCII-7. In standard 7-bit ASCII, the first bit of each character field (MSB) is set to logic zero(0), and the 7-bit ASCII code occupies the remaining seven bits of the field.
- g. Combining numeric data with discrete or coded data in the same word should be avoided.
- h. Packing of discretized with coded data of similar functions within the receiving subsystem should be limited.

2.2.2.1 2's Complement: Several potential implementations for the positioning of 2's complement data were compared with each other and evaluated for consideration as a recommended standard. These implementations are:

- a. Left justification of data and sign bit
- b. Right justification of data and sign bit
- c. Sign left-justified and value right-justified

The format for 2's complement data (see Figure 4) should be one data item per word, left—justified with sign bit in bit position 00.

The sign bit is designated as the leftmost bit of the data word to facilitate use of the arithmetic shift instructions available with many processors. The arithmetic shift instructions will left-justify the data (preparing for transmission) or shift the data to the right (moving received data from input buffer) while maintaining the integrity of the sign bit. This is not possible with right-justified data and sign bit because arithmetic shift instructions assume the sign bit to be bit 00.

MIL-STD-1553

word bit positions

MSB

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

LSB

2's complement

Sign	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Discrete

D	D	D	D	D	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Coded

0	0	C	C	0	C	C	C	C	C	C	C	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(ASCII)

0	A	A	A	A	A	A	A	0	A	A	A	A	A	A	A
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(BCD)

B	B	B	B	B	B	B	B	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Validity

V	V	V	V	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Note:

MSB: Most significant bit
 LSB: Least significant bit
 ASCII: American Standard Code for
 Information Interchange
 BCD: Binary coded decimal

FIGURE 4 - Word Format Example

2.2.2.1 (Continued):

If the data and sign bit were right-justified, special routines would have to be written to move the information to the left since most processors look for the sign bit in the leftmost bit position.

The implementation in which the sign bit is left-justified and the value right-justified provides for range increase with no change to the data word required. However, there are also some problems with this method: (1) extra processing time and memory would be required to put the two pieces of information together for storing and (2) it could require storage of all 16 bits of information regardless of how many bits are actually needed to transfer the data. All but a few of the fixed-point data words examined in the source documents were in the recommended format.

- 2.2.2.2 Unsigned Numeric: Unsigned numeric data is any parameter, whether integer or fractional, that is transmitted only as a positive value. Unsigned numeric data should only be used when 16-bit range or resolution is required. The use of 2's complement representation is highly preferred.

The format for unsigned numeric data should be one data item per word, occupying all 16 bits. The value of the MSB should be an integer power of 2.

- 2.2.2.3 Discrete Bit: Several potential implementations for packing discrete data were compared with each other and evaluated for consideration as a recommended standard. These implementations are:
- Group all data bits in leftmost positions
 - Group all data bits in rightmost positions
 - Intersperse data bits with spares

The format of packing discrete data should be to group only functionally related data bits and pack them on the left side of the word with no spares interspersed (see Figure 4). Discretes should be named so that the name indicates a true (1) condition (e.g., RANGE INVALID = 1).

If all data bits are grouped in the leftmost positions, the leftmost bit can be tested for positive indication, then shifted to the left, the following bit tested and shifted, etc. This software method is an efficient way of processing discrete bits. One reason for this is that it requires less coding because the test-shift routine can be used repeatedly by looping. A single, simple subroutine is therefore capable of handling any grouping of single-bit discrete data fields. Another advantage to putting the data on the left and the spares on the right is that it allows for future expansion with minimal change to existing code.

If the data bits are grouped in the rightmost positions, the entire group of data bits can be read as an integer (without shifting) and this integer value used as an index. Although this is a valid software technique, its application is limited.

By interspersing spares throughout the data, functionally unrelated data can be separated. The disadvantage of this practice is that it can make the system difficult to understand and thus difficult to maintain. In addition, the interspersed spare bits will cause problems if the test-shift method of reading data is used. Rather than use spares as separators, it is recommended that unrelated data be put in different words.

- 2.2.2.4 Coded Bits: Several potential implementations for packing coded data were compared with each other and evaluated for consideration as a recommended standard. These implementations are:
- LSB of each field positioned on a full-, half-, or quarter- word boundary, filling in leftover bits with spares.
 - All data grouped together in the leftmost bits.
 - MSB of each field positioned on a full-, half-, or quarter- word boundary.

The format for packing a coded data type should be to position the LSB of each field on a full—, half—, or quarter—word boundary (see Figure 4).

A coded data type is a parameter set containing uniquely coded values (composed of two or more bits within the set rather than a continuous range of values). Examples of coded data are alphanumerics (ASCII), switch setting codes, and weapon type codes.

It is recommended that the LSB of all fields be placed on full-, half-, or quarter-word boundaries because many processors have instructions to read full-, quarter-, or half-words. If the fields are not on a boundary, the number of instructions is increased, processing time is increased, and the coding becomes more complex.

There are drawbacks to this method. It does not permit easy future expansion within a word. In addition, bus loading may be increased since this method uses more words than would be used if the data were packed in the leftmost bits.

- 2.2.2.5 Validity Bit: Several potential implementations for positioning of validity bits were compared with each other and evaluated for consideration as a recommended standard. These implementations are:
- Positioning the validity bit in the same word as the data item to which it applies.
 - Placing all validity bits in a validity word.

The format should be to place all validity bits in a validity word and to left—justify the validity bits (see Figure 4).

Keeping the validity bit in the same word as the data to which it applies rather than in a separate validity word decreases the bus loading. It also allows only one word at a time to be operated on, thus decreasing processing time.

- 2.2.2.6 Floating Point: The representation of floating point data has been left to the discretion of the system designer. All of the floating point representations examined were based on servicing specific system processors. It is anticipated that this will be true in future systems and, therefore, the floating point representation used should reflect the representation in the target processor. The Army, Navy, and Air Force all have standard floating point representations, described in MIL-STD-1862, AN/AYK-14 Programmer Reference Manual (14122000), and MIL-STD-1750, respectively.

MIL-STD-1862 provides single length (32-bit) and double length (64-bit) floating point representations. The 32-bit representation has a sign bit as the MSB, followed by an 8-bit exponent and a 23-bit fraction. The 64-bit representation has a sign bit as the MSB, followed by an 8-bit exponent and a 52-bit fraction.

MIL-STD-1750 provides 32-bit and 48-bit floating point representations. The 32-bit representation has a sign bit as the MSB, followed by a 23-bit mantissa (fraction) and an 8-bit exponent. The 48-bit representation has a sign bit as the MSB, followed by a 23-bit mantissa, an 8-bit exponent, and 16 bits representing the least significant portion of the mantissa.

The AN/AYK-14 provides a 32-bit floating point representation with the exponent sign bit as the MSB, followed by a 7-bit exponent, a mantissa sign bit, and a 23-bit mantissa.

2.3 How to Construct a Data Word Format:

The purpose of this paragraph is to guide the user through the task of establishing the specific data word formats needed for system integration. The information required to start this process is, as a minimum, a signal list. The task will be easier if more information about each signal is known, such as engineering units (if any), maximum and minimum values, resolution, accuracy, and computation rate. This signal information will be required for each signal of the signal list before the word and message format definition can be completed.

The method for establishing a data word format is presented as a flowchart in Figure 5 with an explanation following:

- a. Select a signal. Example: present position latitude.
- b. Refer to Table V, Index of Signal Categories, and find the category that applies to the signal. In the example signal, present position latitude, the keyword is latitude. Latitude is an angular measurement; therefore, the signal falls in the "angular" category. Note that Table V is divided into categories for signals with engineering units and categories of unitless signals. It will be easier to find the appropriate category if it is known whether the signal is unitless or which units apply. The use of keywords and modifiers associated with each category may aid in identifying the correct category.

After the signal category is determined, go to Step e.

2.3 (Continued):

If the category cannot be determined or there is uncertainty whether the signal really fits in a given category, go to Step c.

- c. If there is still uncertainty about the signal category, get a better definition of the signal. Determine more descriptive or functional details about the signal, including the source, destination, name, and engineering units (if any). Then go back to Step b. Otherwise, go to Step d.
- d. If the signal definitely does not fall into any of the listed categories, refer to paragraph 2.2, General Rules for 15531/1553 Word Construction, for general guidance in establishing the data word format for this signal.
- e. Refer to Table VI, Standard Data Word Format Index. Using the category identified in Step b (from Table V), select the appropriate units and precision, and note the standard data word format table number. Those formats indicated as double precision may be used as either a single or double precision word, based on the requirements of the particular application.

For the example signal, present position latitude, the correct category is "Angular". In the standard data word format column of the table we find and note for later use the reference to Table IX. Find the category of your signal in Table VI and note the tables referenced in the standard data word format column.

- f. Refer to paragraph 2.5, Standard Data Word Formats, and the applicable tables (noted in Step e). Construct the data word format and complete the ICD data sheet(s) for this signal.
- g. A necessary part of data word format development is the selection of a formal signal name for each signal. Refer to paragraph 2.4, Naming, to select the formal signal name. Proceed to Step h.
- h. Select next signal and start the process at Step b.

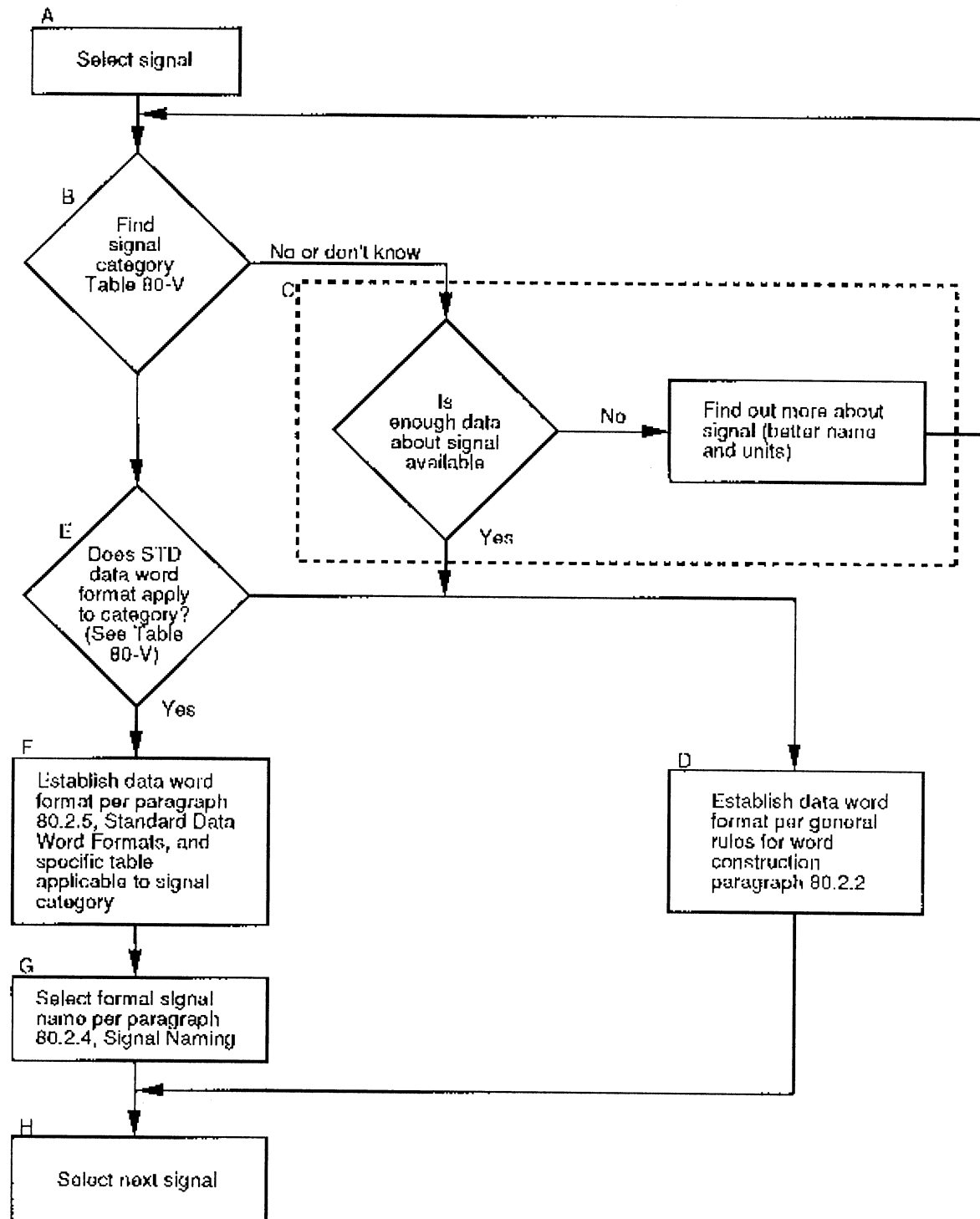


FIGURE 5 - Establishing a Data Word Format

TABLE V - Index of Typical Signal Categories (Sheet 1 of 6)

Acceleration Tables 80-VII and 80-VIII		Angular Table 80-IX		Angular Acceleration Table 80-X		Angular Velocity Table 80-XI		ASCII Data Table 80-XII				
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers			
Acceleration	Down East Lateral Longitudinal Normal North Target, X Target, Y Target, Z Turret X Y Z	Angle	AOA (angle-of-attack) AOA, error AOA, true Drift Ground track Ground track, present Pitch Roll Sideslip Steering Tilt Wander	Acceleration	Down East North Pitch Roll Yaw	Gyro bias	Correction X Correction Y Correction Z	Bar	Horizontal Vertical			
		Azimuth	(Same as azimuth)				Rate	Angular Azimuth Deflection Elevation Pitch Rotation Yaw	Character	Left Middle Right		
						Display			Alpha Border Branch Character Control Data Intensity Miscellaneous Numeric Position Radar Symbol Window			
										Symbol	Control Identification Internal Reference	
												Bearing
												Course
												Elevation
												Heading
												Latitude
												Longitude
		Variation										

TABLE V - Index of Typical Signal Categories (Sheet 2 of 6)

BCD Data Table 80-XIII		Convergence Factor Table 80-XIV		Cosine, Sine Table 80-XV		Counts Tables 80-XVI and 80-XVII		
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	
Channel	Select	Convergence factor	Inserted Present, in use	Cosine	Direction	Counts	Track control, RN	
IFF	Code Control Interrogator				a. CXX (ref. platform to earth CXY coordinate system) CXZ		Track control, n	
ILS	Channel Mode				b. DIRXL (ref. A/C body DIRYL coordinate system) DIRZL		Date	Julian Year
Radio	Select Status Test				c. DIRCOSX (same as b) DIRCOSY DIRCOSZ		Frames	Film recording data
Receiver	Channel Command Frequency Tune				Heading Pitch Roll		Pulses	Ripple
RF	Channel Disposition Level Transmit			Sine	Heading Pitch Roll		Revolutions	Revolutions per minute Rotor speed No. n
TACAN	Channel Mode				Rounds		Remaining	
UHF/VHF	Channel Mode				Words		Instrumentation port data	
VOR	Channel Mode							

TABLE V - Index of Typical Signal Categories (Sheet 3 of 6)

Data Validity Table 80-XVIII and 80-XIX		Deviation Table 80-XX		Cosine, Sine Table 80-XV		Distance Tables 80-XXI through 80-XXV	
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers
Error protection	(None)	Deviation	Glideslope Localizer TACAN VOR XTK	Altitude	Above fixpoint Barometric Barometric reference Desired Electronic Altimeter Helo (Helicopter) Inertial Pressure Radar Sonobuoy launch Store System Target	Rate position	Acquisition cursor
Checksum	Bits Word			Azimuth	Cursor Deviation steering Steering dot	Separation	Impact
Validity	Bit Data Discrete			Circle	Display	Wingspan	(None)
				Distance	To Nth waypoint/markpoint To steerpoint	X	Cursor connection Cursor total Delta Display delta Display position Display - translate Helo position Helo position at initialization Ownship position Pointer position Position Position, fly-to-point Sonobuoy position Symbol position
				Easting	Inserted position Inserted waypoint Nth waypoint/markpoint MGRS Present position MGRS	Y	(Same as X)
				Elevation	(Same as azimuth)	Z	Cursor total Position
				Error	Allowable steering Crosstrack Position east Position north		
				Height	Above target (HAT)		
				Northing	(Same as easting)		
				Range	Aircraft symbol Contact Ground track, incremental Manual Maximum Minimum Pull up Radar Slant TACAN Tactical X, relative target Y, relative target Z, relative target		

TABLE V - Index of Typical Signal Categories (Sheet 4 of 6)

Flow Tables 80-XXVI and 80-XXVII		Frequency Tables 80-XXVIII through 80-XXX		Mass Tables 80-XXXI and 80-XXXII		MGRS Table 80-XXXIII		Percent Table 80-XXXIV	
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers
Fuel	(None)	Frequency	ADF-n	Mass	Aircraft Fuel Ordnance Payload	MGRS	Area Datum Grid zone Easting Northing Spheroid 100,000 meter Grid square Ellipsoid	Percent	(None)
Oil	(None)		HF-n UHF-n VHF-n VOR-n ILS -n						

TABLE V - Index of Typical Signal Categories (Sheet 5 of 6)

Pressure Tables 80-XXXV and 80-XXXVI		Ratio Table 80-XXXVII		Temperature Table 80-XXXVIII		Time Tables 80-XXXIX through 80-XLIII	
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers
Differential	Pressure altitude	Ratio	Air density Pressure	Temperature	Celsius Engine inlet Exhaust gas Fuel inlet Outside air Total True freestream air	Calendar	(None)
Discharge	Compressor turbine					Clock	Kalman
Oil	Engine Transmission					Time	Align Almanac reference Coordinated universal Greenwich mean Of day Sonobuoy, last correct Sonobuoy launch Symbol Tag
Impact	Indicated					Time to	Destination Go Nth waypoint/markpoint Steerpoint
Static	Indicated					Pulse	Width Repetition interval
Fuel							

TABLE V - Index of Typical Signal Categories (Sheet 6 of 6)

Torque Table 80-XLIV		Vector word Table 80-XLV		Velocity Tables 80-XLVI through 80-L		Voltage Table 80-LI	
Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers	Keyword	Typical Modifiers
Engine	(None)	Asynchron- ous	Message demand	Airspeed	Calibrated Indicated True	Voltage	Display intensity Fore/aft cursor deflection Left/right cursor deflection Stick X deflection Stick Y deflection
Shaft	(None)		Action demand	Groundspeed	Predicted Present Tail warning system		
				Mach	Number		
				Range rate	None		
				Speed	Bias Desired Ground Helo Helo wind Ownship Symbol True Water		
				Velocity	Correction X Correction Y Doppler drift Doppler heading Doppler vertical Down Drift East Heading North Vertical Wind X X, relative target Y Y, relative target Z Z, relative target		

2.4 Naming:

A necessary part of data word format development is the selection of a formal signal name for each signal. A naming convention will make signals more easily traceable within an integrated system as well as across various systems.

The basic principle for naming signals consistently is placing the most important word (keyword) first, followed by modifiers. The keyword is the word most closely related to the category or engineering units (if any) of the signal. The keyword may be the same as the signal category. Appropriate modifiers should be added as required to create a unique signal name for each data word within the system. For example, "latitude, present position, INS."

Table V presents typical signal names by category. Within each category is a list of keywords associated with that category and some typical modifiers associated with those keywords. This table should be helpful in selecting a formal signal name by using the following procedure:

- a. Find the appropriate category for your signal. For our example signal, present position latitude, the category is "Angular".
- b. Determine if your signal's keyword is listed. For the example signal, present position latitude, the keyword is "latitude".
- c. If your signal's keyword is not listed under the appropriate category, consider using the category name as your signal's keyword. If the category name is an inappropriate keyword for your signal, choose the most meaningful word in the name as the keyword.
- d. Define your signal's formal name by placing the keyword first, followed by the remaining words (modifiers). Table V also lists some typical modifiers for common keywords. The formal name for our example signal would therefore be "latitude, present position."
- e. Return to paragraph 2.3 to complete data word format definition.

2.5 Standard Data Word Formats:

This paragraph presents the standard data word formats, and provides the user guidance necessary to fit real-life signals into the standard data word formats. An example signal is used to illustrate the application of the standard data word formats to real-life signals. The derivation of the example data word is presented in the following paragraphs, and the completed data word format is presented in Figure 6. Figure 7 depicts the standard vehicle fixed-axis coordinate system. Other coordinate systems referenced in the ICD should be similarly illustrated.

Table VI is an index that keys the user into the various standard data word formats. The standard data word formats are presented in Tables VII through LI. Having established the category of your signal (by following the steps outlined in paragraph 2.3), refer to the appropriate standard data word format(s), as indexed in Table VI, and to the following example for guidance.

TABLE VI - Standard Data Word Format Index

CATEGORY	UNITS	WORD(s) / PRECISION	TABLE No.
Acceleration	Meters/Sec/Sec	Double	VII
	Feet/Sec/Sec	Single	VIII
Angular	Semicircles	Double	IX
Angular Acceleration	Semicircles/Sec/Sec	Single	X
Angular Velocity	Semicircles/Sec	Double	XI
ASCII Data	N/A (Character)	One	XII
BCD Data	N/A (Channel Select)	One	XIII
Convergence Factor	N/A	Single	XIV
Cosine/Sine	N/A	Double	XV
Counts	N/A (Signed)	Single	XVI
	N/A (Unsigned)	Single	XVII
Data Validity	N/A (Checksum)	Single	XVIII
	N/A (Error Protection)	One	XIX
Deviation	Diff. in Depth of Modulation	Single	XX
Distance	Meters	Double	XXI
	Feet	Double	XXII
	Kilometers	Double	XXIII
	Nautical Miles (Low Range)	Single	XXIV
	Nautical Miles (High Range)	Double	XXV
Flow	Kilograms/Hour (Low Range)	Single	XXVI
	Kilograms/Minute (High Range)	Single	XXVII
Frequency	Hertz	Four	XXVIII
	Kilohertz (ADF)	One	XXIX
	Megahertz (UHF/VHF/HF)	One	XXX
Mass	Kilograms (Low Range)	Single	XXXI
	Kilograms (High Range)	Single	XXXII
MGRS	N/A	Five	XXXIII
Percent	N/A	Single	XXXIV
Pressure	Kilopascals	Double	XXXV
	Inches of Mercury	Single	XXXVI
Ratio	N/A	Single	XXXVII
Temperature	Celsius	Single	XXXVIII
Time	Month, Day, Hour, Minute, Second	Three	XXXIX
	Microseconds (Time Tag)	Double	XL
	Seconds (Time To)	Single	XLI
	Microseconds (PRI)	Single	XLII
	Nanoseconds (Pulse Width)	Single	XLIII
Torque	Newton-Meters	Double	XLIV
Vector Word	N/A	Single	XLV
Velocity	Meters/Sec	Double	XLVI
	Feet/Sec	Double	XLVII
	Kilometers/Hour	Single	XLVIII
	Knots	Single	XLIX
	Mach Number	Single	L
Voltage	Volts	Double	LI

2.5 (Continued):

An effective means of guiding the user in establishing data word formats for his signals is by example. We have been using a typical signal, "latitude, present position," as our example. The data word format for this signal is derived as follows. It is necessary to have certain information about the signal before the data word format can be defined. For signals that have engineering units, the minimum necessary information is as follows:

- a. The formal word name (established in paragraph 2.4)
- b. The engineering units
- c. The range (maximum and minimum) of signal value
- d. The accuracy required

The following information is used in our example:

WORD NAME	:	LATITUDE
UNITS	:	DEGREES
RANGE	:	±90 DEGREES (POSITIVE IS NORTH)
ACCURACY	:	0.00000273 DEGREES

Refer to the index in Table VI. We established that the category of our example signal is "angular." The index refers us to Table IX for angular category, double precision. Proceed as follows to decide whether data word will be single or double precision:

- a. Is RANGE of signal covered by MAX VALUE and MIN VALUE of standard data word format? If not, define data word format for the signal by using the General Rules for Word Construction, paragraph 2.2, and the standard data word formats as examples.

The RANGE of our signal is ±90 DEGREES. We see that the UNITS of the standard data word format are SEMICIRCLES (1 semicircle = 1 pi radian), so we must convert all signal parameters from DEGREES to SEMICIRCLES. To convert, divide DEGREES by 180. The signal RANGE (±90 DEGREES) becomes ±0.5 SEMICIRCLES, and is within the MAX VALUE (+1) and MIN VALUE (-1) of the standard format.

- b. Can the required signal ACCURACY be transmitted using the single precision standard format? If yes, proceed; if no, can double precision standard format accommodate ACCURACY? If yes, proceed; if no, refer to paragraph 2.2, General Rules for 15531/1553 Word Construction, and define data word format for the signal using the standard data word formats as examples.

The example signal's required ACCURACY is 0.00000273 DEGREES, or, after conversion, 0.0000000152 SEMICIRCLES. The LSB value of the first word of the standard format is 2^{-15} (i.e., 0.0000305176) SEMICIRCLES. The format with accuracy of 0.0000305176 cannot accommodate the 0.0000000152 accuracy required. The LSB value of the double precision standard format is 2^{-31} (i.e., 0.00000000466) SEMICIRCLES, which is sufficient to accommodate the 0.0000000152 signal accuracy.

DOC. NO. *

REV. *

DATE *

SHEET 1 OF 1

WORD NAME : Latitude, Present Position, INS

WORD ID : INS 03-FCC 12-04/05

MAX VALUE : 0.5

SOURCE(S) : INS

MIN VALUE : -0.5

DEST(S) : FCC

RESOLUTION : 3.7252E-9

COMP RATE : 8

ACCURACY : 0.0000000152

XMIT RATE : 8

MSB : 0.5

SIGNAL TYPE : 2's complement

LSB : 4.6566E-9

UNITS : Semicircles

FULLSCALE : 0.9995343387

FIELD NAME	BIT NO.	DESCRIPTION
Latitude	MSW -00-N	Sign
	-01-N	MSB -----
	-02-N	
	-03-N	
	-04-N	
	-05-N	
	-06-N	
	-07-N	
	-08-N	
	-09-N	
	-10-N	
	-11-N	
	-12-N	
	-13-N	
	-14-N	
	-15-N	
	LSW -00-N	
	-01-N	
	-02-N	
	-03-N	
	-04-N	
	-05-N	
	-06-N	
	-07-N	
	-08-N	
	-09-N	
	-10-N	
	-11-N	
	-12-N	RESOLUTION: 3.7252 E-9
	-13-0	
	-14-0	
	-15-0	LSB -----

REMARKS: Positive Sense: Plus is North

* - Application Dependent

FIGURE 6 - Data Word Format for Example Signal