TRK-2-14

DSN TRACKING SYSTEM INTERFACES
METRIC DATA ASSEMBLY HSD INTERFACE

(Insert this modular document in 820-13; Rev. A)

EFFECTIVE DATE: 1 February 1978

Initial Release Date: 15 July 1977

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A. PURPOSE.

This module specifies the variable data format of the radio metric data from the Deep Space Network as of 1 January 1978. (Exact effective date will be dependent on available resources.) The content and format of each radio metric high speed data (HSD) block generated and transmitted by the Metric Data Assembly (MDA) are herein detailed.

Until the effective date of this module (TRK-2-14), the MDA will be implemented to generate data in the HSD format as given in TRK-2-11. The TRK-2-11 format will be provided for all projects requiring IBM 360-75 support.

B. REVISION AND CONTROL.

Revisions or changes to information herein presented may be initiated in accordance with procedures given in Section I of this document.

This is a new module

Change:

C. GENERAL INFORMATION.

This interface assumes the Ground Communications Facility (GCF) is transparent except for imposing certain constraints concerning the use of HSD lines. These constraints are:

(1) The rate of the HSD line shall be 7200 bps
(2) Data shall be sent in 1200 bit blocks. (1200 bit block size is current standard. Future standard may increase block size to 4800 bit blocks.)

The radio metric data will be generated at 10-per-second doppler rate and stored on a High Rate Data Record (HRDR). The requested radio metric data sample rates will be formatted into HSD blocks and transmitted to the data user and also will be stored at the DSS as an Original Data Record (ODR). Meteorological data blocks as defined in TRK-2-12 will also be transmitted from the MDA or CMFA via HSD lines (UDT F 027_8). Additional MDA configuration and mode control blocks as defined in 820-14 will also be transmitted from the MDA to NOCC via HSD lines.

D. DATA BLOCK FORMAT AND FIELDS.

1. Generalized Data Block Format.

The generalized data block format is shown in Figures TRK-2-14-1 and TRK-2-14-2. The first 120 bits of the block, called the "header", contain 12 fields as follows:

(a) Sync code (24 bits): Always $627\ 627_{16}$ and are used by the GCF to sync the 1200 bit block.
(b) Source (8 bits): The source code assignments as given in Table OPS-6-6-3A of Module OPS-6-6.
(c) Destination (8 bits): 310_8 (MCCC) as destination for realtime and HRDR recall data; 267_8 for ODR recall data (OPS-6-6)

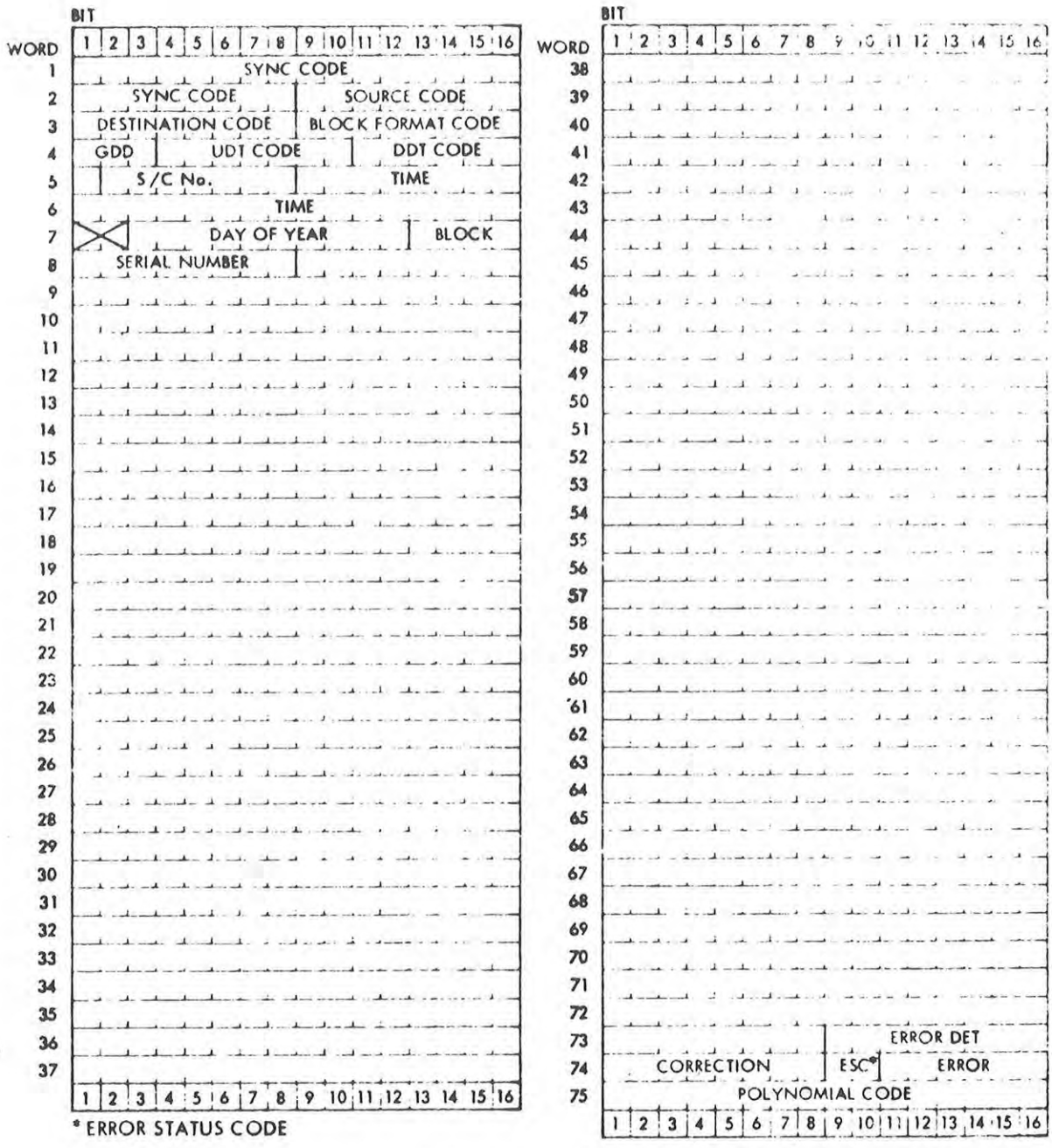

Figure TRK-2-14-1. GCF 1200-Bit High Speed Data Block 22-Bit Error Polynomial

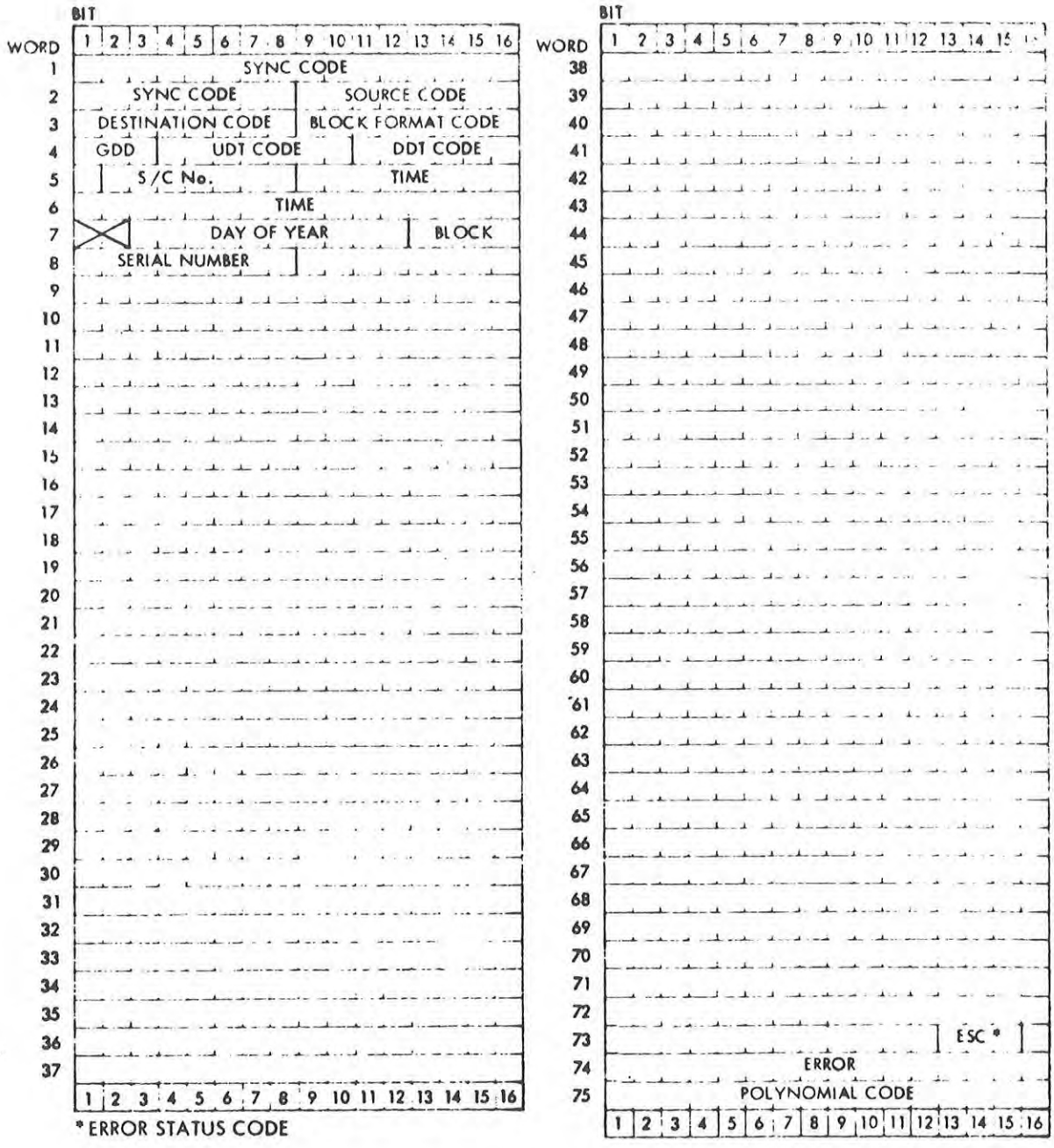

Figure TRK-2-14-2. GCF 1200-Bit High Speed Data Block 33-Bit Error Polynomial

(d) Block Format Code (8 bits): DE (HEX) indicating a 1200-bit HSD block with a 22-bit GCF error polynomial and 31 (HEX) for a 1200-bit HSD block with a 33-bit GCF error polynomial.

(e) Gross Data Description (3 bits): A 000_2 will be used for real-time transmissions, 001_2 will be used to indicate ODR recall and 011_2 will be used for HRDR replay.

(f) User Data Type (7 bits): A 026_8 is used to identify Radio Metric Data.

(g) Data Dependent Type (7 bits): A 022_8 is used to identify the real-time or ODR recall and 130_8 is used to identify HRDR recall.

(h) Spacecraft identification (7 bits): This is a unique number which specifies the spacecraft associated with the data in the block and is given in Table OPS-6-6-7A of Module OPS-6-6 of this document.

(i) Time of Day (24 bits): This is given as a binary integer in units of one-hundredths of a second after 00:00:00 GMT of the current day. Time of day is the same as the time of the first data type sample in the HSD block.

(j) Reserved (2 bits): The first two bits of Word 5 are reserved for future use. At the present time both bits are set to zero.

(k) Day of Year (10 bits): This is given in binary coded decimal (BCD) where 1 January of a year is day one. Bits 1 and 2 = 100's of Day of Year. Bits 3-6 = 10's of Day of Year. Bits 7-10 = units of Day of Year.

(l) Data Block Serial Number (12 bits): This binary number (modulo 4096) is incremented by one for each radio metric block transmitted. The Data Block Serial Number is unique for each User Data Type (UDT) and Source.

2. Block Information Field.

Following the HSD block header, the next 1040 bits, called the Block Information Field (BIF), contain the radio metric data. The BIF contains the following variable data types:

0-23	Not used
24-29	Reserved for system use
30	End of data for this block and this pass. (A pass may be closed out with a HSD block containing DT-30 only.)
31	End of data for this block, but not end of pass
32-36	Reserved for Radio Metric Data
37	Low rate doppler data
38	High rate doppler data
39	Angle data
40	Range data
41	DRVID data
42	Programmed oscillator frequency
43	Radio metric validation data
44-63	Reserved for additional data types

The content of data types 30, 31, 37, 38, 39, 40, 41, 42, and 43 is contained in Tables TRK-2-14-1 through TRK-2-14-8.

a. Variable Data Block (VDB) and Data Types. The variable data block is a standard 1200-bit high speed data block constructed of variable data types and filler bits. Consecutively, following the GCF header are the radio metric data types. When there is no further room to add a complete data type (Note: Data types will not be split between VDBs), a trailer data type (DT 30 or 31) will be inserted. The remainder of the data portion of the data block will be filled by filler data. The DSS will transmit radio metric data via the GCF using a UDT of 026_8. The NOCC will transmit requests for radio metric data, binary predictions, mode and configuration to the DSS using a UDT of 021_8.

b. Data Types and Parameter Fields. Each data type will consist of one or more parameter fields, the first of which is a 6-bit data type ID code.

Table TRK-2-14-1. End of Data Radio Metric Data

Data Type	Parameter	Bits/ Parameter	LSB	Units	Comments
30	End of Data for This Block and This Pass	6	2^0	Integer	
31	End of Data for This Block, but not End of Pass	6	2^0	Integer	DT-31 sent only if greater than or equal to 6 bits available at the end of BIF

LSB = Least Significant Bit

Table TRK-2-14-2. Content of Data Type 37 (Low Rate Doppler Data) (sheet 1 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Data Type ID	6	2^0	-	Binary	
Doppler Frequency Band	1	-	-	0 = X-Band; 1 = S-Band	
Channel No.	3	2^0	-	Binary	1
Doppler Mode	2	-	-	00 = Coherent 3-Way; 01 = 1-Way; 10 = 2-Way; 11 = 3-Way	
GMT	17	2^0	Seconds	Binary Seconds Past "0" Hours: Always Positive	
Doppler Count	42	2^{-10}	Cycles	Modulo 2^{31}, Always Positive	2
Exciter Frequency	37	2^{-10}	Hz	Always Positive	3
Frequency Standard Reference	1	-	-	0 = Backup; 1 = Prime	4
Receiver Type	2	-	-	00 = Block III; 01 = Block IV; 11 = Spare; 10 = Blk III	5
Doppler Receiver Reference	4	2^0	-	Binary Receiver No., Always Positive; 1111 = Not Available	6
Doppler Bias	1	2^0	-	0 = -1 MHz; 1 = +1 MHz	
Exciter VCO Reference	2	-	-	00 = Short; 01 = Synthesizer; 10 = Not Available; 11 = Spare	7
Transmitter On/Off	1	-	-	0 = Off; 1 = On	

Table TRK-2-14-2. Content of Data Type 37 (Low Rate Doppler Data) (sheet 2 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
FTS Frequency Status	2	-	-	00 = Bad; 01 = Good; 10 = Not Available; 11 = Spare	8
FTS Clock Status	2	-	-	00 = Bad; 10 = Good; 10 = Not Available; 11 = Spare	9
Doppler Manual Good/ Bad Switch	1	-	-	0 = Bad; 1 = Good	9A
Receiver Lock Status	1	-	-	0 = Out; 1 = In	10
DTK Software Configuration	1	-	-	0 = Bad; 1 = Good	11
DTK Hardware	1	-	-	0 = Bad; 1 = Good	12
Doppler Residual	31	2^{-10}	Hz	Two's Complement*	13
Doppler Noise	14	2^{-10}	Hz	Always Positive*	14
Doppler Figure of Merit	8	2^{-4}	dB	Two's Complement*	15
Slipped Cycles During Count	10	2^{0}	Cycles	Two's Complement*	16
Total Slipped Cycles During Count	10	2^{0}	Cycles	Always Positive*	17

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-2. Content of Data Type 37 (Low Rate Doppler Data) (sheet 3 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Doppler Residual Tolerance	1	-	-	0 = Out; 1 = In	18
Doppler Noise Tolerance	1	-	-	0 = Out; 1 = In	19
Total Doppler Slipped Cycle Tolerance	1	-	-	0 = Out; 1 = In	20
Received Signal Strength	13	2^{-4}	dBm or Volts	Two's Complement*; If Absolute Value <10.0, then Output is in Volts	21
Differential Doppler Phase	31	2^{-10}	Cycles	Two's Complement, Modulo 2^{20}	22
Reference Channel for Differential Doppler	3	2^{0}	-	Binary Channel No., Always Positive	23
Sample Interval	10	2^{0}	Seconds	Binary Seconds, Always Positive	24 24A
TOTAL =	260 Bits				

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-3. Content of Data Type 38 (High Rate Doppler Data) (sheet 1 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Data Type ID	6	2^0	-	Binary	
Doppler Frequency Band	1	-	-	0 = X-Band; 1 = S-Band	
Channel No.	3	2^0	-	Binary	1
Doppler Mode	2	-	-	00 = Coherent 3-Way; 01 = 1-Way; 10 = 2-Way; 11 = 3-Way	
GMT	17	2^0	Seconds	Binary Seconds Past "0" Hours: Always Positive	
Doppler Count	42	2^{-10}	Cycles	Modulo 2^{31}, Always Positive	2
Exciter Frequency	37	2^{-10}	Hz	Always Positive	3
Frequency Standard Reference	1	-	-	0 = Backup; 1 = Prime	4
Receiver Type	2	-	-	00 = Block III; 01 = Block IV; 11 = Spare; 10 = Blk III	5
Doppler Receiver Reference	4	2^0	-	Binary Receiver No., Always Positive; 1111 = Not Available	6
Doppler Bias	1	-	-	0 = -1 MHz; 1 = +1 MHz	
Exciter VCO Reference	2	-	-	00 = Short; 01 = Synthesizer; 10 = Not Available; 11 = Spare	7
Transmitter On/Off	1	-	-	0 = Off; 1 = On	

Table TRK-2-14-3. Content of Data Type 38 (High Rate Doppler Data) (sheet 2 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
FTS Frequency Status	2	-	-	00 = Bad; 01 = Good; 10 = Not Available; 11 = Spare	8
FTS Clock Status	2	-	-	00 = Bad; 10 = Good; 10 = Not Available; 11 = Spare	9
Doppler Manual Good/ Bad Switch	1	-	-	0 = Bad; 1 = Good	9A
Receiver Lock Status	1	-	-	0 = Out; 1 = In	10
DTK Software Configuration	1	-	-	0 = Bad; 1 = Good	11
DTK Hardware	1	-	-	0 = Fail; 1 = No Fail	12
Doppler Residual	31	2^{-10}	Hz	Two's Complement*	13
Doppler Noise	14	2^{-10}	Hz	Always Positive*	14
Doppler Figure of Merit	8	2^{-4}	dB	Two's Complement*	15
Slipped Cycles During Count	10	2^{0}	Cycles	Two's Complement*	16
Total Slipped Cycles During Count	10	2^{0}	Cycles	Always Positive*	17

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-3. Content of Data Type 38 (High Rate Doppler Data) (sheet 3 of 3)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Doppler Residual Tolerance	1	-	-	0 = Out; 1 = In	18
Doppler Noise Tolerance	1	-	-	0 = Out; 1 = In	19
Total Doppler Slipped Cycle Tolerance	1	-	-	0 = Out; 1 = In	20
Received Signal Strength	13	2^{-4}	dBm or Volts	Two's Complement*; If Absolute Value <10.0, then Output is in Volts	21
Differential Doppler Phase	31	2^{-10}	Cycles	Two's Complement, Modulo 2^{20}	22
Reference Channel for Differential Doppler	3	2^{0}	-	Binary Channel No., Always Positive	23
Short Doppler Samples (9)	261	2^{-10}	Cycles	9 Short Doppler Samples at 10 per Second, Modulo 2^{17}, Always Positive	25
TOTAL =	511 Bits				

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-4. Content of Data Type 39 (Angle Data)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Data Type ID	6	2^0	-	Binary	
Angle Type	2	-	-	00 = HA/DEC; 01 = AZ/EL; 10 = 85 X/Y; 11 = Spare	26
Angle Mode	3	-	-	See Table TRK-2-14-10	
GMT	17	2^0	Seconds	Binary Seconds Past "0" Hours GMT; Always Positive	
Angle 1	19	2^{-10}	Deg	Always Positive	
Angle 2	19	2^{-10}	Deg	Always Positive	
Angle 1 Residual	16	2^{-10}	Deg	Two's Complement*	27
Angle 2 Residual	16	2^{-10}	Deg	Two's Complement*	28
Angle Status	1	-	-	0 = Bad; 1 = Good	29
Conscan Mode	2	-	-	00 = Conscan Off; 01 = Conscan Auto; 10 = Conscan Manual; 11 = Spare	
Angle 1 Tolerance	1	-	-	0 = Out; 1 = In	30
Angle 2 Tolerance	1	-	-	0 = Out; 1 = In	31
Sample Interval	10	2^0	Sec	Binary Seconds	24
TOTAL =	113 Bits				

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-5. Content of Data Type 40 (Range Data) (sheet 1 of 4)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Data Type ID	6	2^0	-	Binary	
Range Frequency Band	1	-	-	0 = X-Band; 1 = S-Band	
Range Mode	2	-	-	00 = Coherent 3-Way; 01 = 1Way; 10 = 2-Way; 11 = 3-Way	
End of Acquisition Time	17	2^0	-	Binary Seconds Past "0" Hours, Always Positive	32
Range	37	2^{-6}	Range Units	Always Positive	
Range Modulation On/Off	1	-	-	0 = Off; 1 = On	
Range Type	2	-	-	00 = Discrete; 01 = Continuous; 10 = R & D; 11 = Spare	33
Highest Frequency Component	4	2^0	-	Binary, Always Positive	34
Lowest Frequency Component	5	2^0	-	Binary, Always Positive	35
Range Time (T_0)	17	2^0	Seconds	Binary Seconds Past "0" Hour, Always Positive	36
Clock Component Integration (T_1)	15	2^0	Seconds	Binary Seconds, Always Positive	37

Table TRK-2-14-5. Content of Data Type 40 (Range Data) (sheet 2 of 4)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Component Integration (T_2)	12	2^0	Seconds	Binary Seconds, Always Positive	38
DRVID Integration (T_3)	12	2^0	Seconds	Binary Seconds, Always Positive	39
Prime Range Channel	1	-	-	0 = X-Band; 1 = S-Band	40
Pipelining	1	-	-	0 = Off; 1 = On	41
Chopper Freq	1	-	-	0 = Off; 1 = On	42
Round Trip Light Time	14	2^0	Seconds	Binary Seconds, Always Positive	
Carrier Suppression	9	2^0	dB/volts	Two's Complement	43
Carrier Suppression (Volts/dB)	1	2^0	-	0 = Volts, 1 = dB	43
Range Validity	1	-	-	0 = Bad; 1 = Good	44
Range Calibration	19	2^{-6}	Range Units	Always Positive	45
Range Calibration Tolerance	1	2^0	-	0 = Out; 1 = In	
Range Configuration	1	2^0	-	0 = Different; 1 = Same	46
0° Correlation Voltage	11	2^0	Millivolts	Two's Complement*	47
90° Correlation Voltage	11	2^0	Millivolts	Two's Complement*	48

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-5. Content of Data Type 40 (Range Data) (sheet 3 of 4)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Range Pr/No.	11	2^{-4}	dB	Two's Complement*	49
Range Pr/No. Tolerance	1	-	-	0 = Out; 1 = In	50
Range Residual	28	2^{-6}	Range Units	Two's Complement*	51
Average Doppler Residual	21	2^{-10}	Hz	Two's Complement*	52
Range Residual Tolerance	1	-	-	0 = Out; 1 = In	53
Pseudo DRVID	28	2^{-6}	Range Units	Two's Complement*	54
Pseudo DRVID Tolerance	1	-	-	0 = Out; 1 = In	55
Differenced S-X Range	22	2^{-6}	Range Units	Two's Complement*	56
Differenced S-X Range Tolerance	1	-	-	0 = Out; 1 = In	57
Z Correction	20	2^{-6}	Nano-seconds	Always Positive	58
Wave Form Distortion	13	2^{-6}	Range Units	Two's Complement	59

*If computed value exceeds field size, set to maximum value with appropriate sign.

Table TRK-2-14-5. Content of Data Type 40 (Range Data) (sheet 4 of 4)

Parameter	Bits/ Parameter	LSB	Data Units	Comments	Explanatory Note (Appendix)
Receiver No.	4	2^0	-	Binary Receiver No.; Always Positive; 1111 = Not Available	
Exciter No.	1	-	-	0 = Block III; 1 = Block IV	
Maser No.	2	2^0	-	Binary Maser No.; Always Positive; 11 = Not Available	
Maser Type	2	-	-	00 = ; 01 = ; 10 = ; 11 = Not Available	
Transmitter	1	-	-	0 = Low Power; 1 = High Power	
Transmitter Power Level	13	2^{-7}	Volts/ KW		60
Tx Power Flag	1	2^0	-	0 = Volts; 1 = KW	61
Doppler Counter at T_0	42	2^{-10}	Counts		62
Exciter Freq. at T_0	37	2^{-10}	Hz		63
TOTAL =	452 Bits				