DOCUMENT 161-00

DATA REDUCTION AND COMPUTER GROUP

IRIG DATA FORMATS
FOR
INTERRANGE TRANSMISSION OF TRACKING DATA
FROM
COMPUTER TO COMPUTER
(EFG, RAE, AND XYZ FORMATS)

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ABERDEEN TEST CENTER
NATIONAL TRAINING CENTER
ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISON
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
PACIFIC MISSILE RANGE FACILITY
NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR ARMAMENT CENTER
AIR WARFARE CENTER
ARNOLD ENGINEERING DEVELOPMENT CENTER
GOLDWATER RANGE
UTAH TEST AND TRAINING RANGE
NEVADA TEST SITE

DISTRIBUTION A: APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 2000	

4. TITLE AND SUBTITLE
IRIG Data Formats for Interrange Transmission of Tracking Data from Computer to Computer (EFG, RAE, and XYZ Formats)

5. FUNDING NUMBERS

6. AUTHOR(S)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Data Reduction and Computer Group
Range Commanders Council
White Sands Missile Range, NM 88002-5110

8. PERFORMING ORGANIZATION REPORT NUMBER
Document 161-00

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
CSTE-DTC-WS-RCC
Range Commanders Council
White Sands Missile Range, NM 88002-5110

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
same as block 8

11. SUPPLEMENTARY NOTES
Supersedes Document 161-85, AD-A163251, which is obsolete. Please remove 161-85 from distribution.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution A: Approved for Public Release; Distribution is Unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The formats defined in this document are used by the national and service ranges for interchange of data. Currently there are 9 formats and 11 format subdivisions for interrange transmission of real-time tracking data from a computer on one range to a computer on another range.

14. SUBJECT TERMS
interrange transmission of data, TSPI, tracking data

15. NUMBER OF PAGES
56

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
unclassified	unclassified	unclassified	none

IRIG STANDARD 161-00

IRIG DATA FORMATS
FOR
INTERRANGE TRANSMISSION OF TRACKING DATA
FROM
COMPUTER TO COMPUTER
(EFG, RAE, AND XYZ FORMATS)

MARCH 2000

Prepared by

DATA REDUCTION AND COMPUTER GROUP
RANGE COMMANDERS COUNCIL

Published by

Secretariat
Range Commanders Council
U.S. Army White Sands Missile Range
New Mexico 88002-5110

THIS DOCUMENT IS AVAILABLE ON THE
RANGE COMMANDERS COUNCIL WEBSITE
AT
http://tecnet0.jcte.jcs.mil

TABLE OF CONTENTS

	Page
ACRONYMS	v
PURPOSE	1
APPLICATIONS	1
LIMITATIONS	1
COORDINATE SYSTEM DEFINITIONS	1
MATRIX OF FORMATS AND FORMAT USERS	2
FORMAT DEFINITIONS AND FIGURES	3-46
Format 0 – IRIG 240-Bit Format (EFG)	3
Format 0A – IRIG 240-Bit Format (EFG)	6
Format 0B – IRIG 240-Bit Format (EFG)	7
Format 0C – IRIG 240-Bit Format (EFG)	8
Format 1 – IRIG 240-Bit Format (RAE)	9
Format 1A – IRIG 240-Bit Format (RAE)	11
Format 1B – IRIG 240-Bit Format (RAE)	13
Format 1C – IRIG 240-Bit Format (RAE)	14
Format 2 – IRIG 240-Bit Format (EFG)	15
Format 2A – IRIG 240-Bit Format (EFG)	18
Format 2B – IRIG 240-Bit Format (EFG)	19
Format 2C – IRIG 240-Bit Tracking Data for PMRF and KMR	20
Format 3 – IRIG 240-Bit Two-Radar Format (RAE or EFG)	22
Format 3A – IRIG 240-Bit Two Raw Data Radar Format (RAE)	24
Format 4 – IRIG 240-Bit Two Data Point Frame Format (RAE)	25
Format 4A – IRIG 240-Bit Format (RAE)	28
Format 5 – IRIG 240-Bit (ARDC) Format (RAE)	29
Format 6 – IRIG 240-Bit Format (RAE)	31
Format 7 – IRIG 448-Bit (AWC) Format (XYZ)	33
Format 8 – IRIG 240-Bit (MDDF) Format (RAE)	36
Format 9 – IRIG 1200-Bit (Space Shuttle) Format (RAE or EFG)	39

LIST OF FIGURES

Figure No.		Page
1	Range to Range Real-Time TSPI Data Links	2
2	IRIG 240-Bit (KMR, PMRF, and ARGUS Aircraft Data) Format 0	5
3	IRIG 240-Bit (ETR) Format 0A	6
4	IRIG 240-Bit (ETR) Format 0B	7
5	IRIG 240-Bit (NASA LTAS) Format 0C	8
6	IRIG 240-Bit (NAWCWD Point Mugu) Format 1	10
7	IRIG 240-Bit (SW 30) Format 1A	12
8	IRIG 240-Bit (RAE) Format 1B	13
9	IRIG 240-Bit (Western Range) Format 1C	14
10	IRIG 240-Bit (PMRF) Format 2	17
11	IRIG 240-Bit (Western Range) Format 2A	18
12	IRIG 240-Bit (Western Range) Format 2B	19
13	IRIG 240-Bit (PMRF Format Tracking Data, and KMR) Format 2C	21
14	IRIG 240-Bit (Two Radar, NASA) Format 3	23
15	IRIG 240-Bit (Two Radar, ETR) Format 3A	24
16	IRIG 240-Bit (Two Data Point Frame, AFFTC) Format 4	27
17	IRIG 240-Bit (Two Data Point Frame, China Lake) Format 4A	28
18	IRIG 240-Bit (ARDC, EPG) Format 5	30
19	IRIG 240-Bit Format 6	32
20	IRIG 448-Bit (AWC, Tyndall) Format 7	34
21	IRIG 240-Bit (MDDF, NASA) Format 8	38
22	IRIG 1200-Bit (Space Shuttle) Format 9	40

ACRONYMS AND INITIALISMS

30 SW	30th Space Wing, Vandenburg AFB, CA
45 SW	45th Space Wing, Patrick AFB, FL
A	angle
AAC	Air Armament Center, Eglin AFB, FL
A/B	auto beacon
AFDTC	Air Force Development Test Center, Eglin AFB, FL
AFFTC	Air Force Flight Test Center, Edwards AFB, CA
AO	azimuth override
A/S	auto skin
AT	auto track
AWC	Air Warfare Center, Tyndall AFB, FL
AZ	azimuth angle
BAMS	binary angular measurement system
BCD	binary coded decimal
BPS	bits per second
BS	skin/beacon mode
CD	computer drive mode
CRC	cyclic redundancy code
CT	coherent tract
dB	decibel
DD	destruct Doppler
DI	droop
DP	Doppler
DQ	data quality
EFG	E-axis, F-axis, G-axis
EL	elevation
EO	elevation override
EPG	Electronic Proving Ground, Ft. Hauchuca, AZ
ER	Eastern Range
ETR	Eastern Test Range
GMT	Greenwich Mean Time
GRDCS	gulf range drone control system
ICC	Instrumentation Control Center
ID	identification
IRIG	Interrange Instrumentation Group
Kaena Pt	Kaena Point, Oahu, HI
kbps	kilobar per second
KMR	Kwajalein Missile Range, Kwajalein Atoll, Pacific Ocean
L	liftoff
LFI	last frame indicator
LO	liftoff

LSB	least significant bit
MIPIR	missile precision instrumentation radar
M/S	manual/skin mode
MSB	most significant bit
msec	millisecond
NASA	National Aeronautics and Space Administration
NAWCAD	Naval Air Warfare Center Aircraft Division, Pax River, MD
NAWCcl	Naval Air Warfare Center, China Lake, CA
NAWCpm	Naval Air Warfare Center, Point Mugu, CA
NAWCpr	Naval Air Warfare Center, Pax River, MD
NAWCWD(cl or pm)	Naval Air Warfare Center Weapons Division, China Lake, CA; or Point Mugu, CA
NU	not used
OA	on-axis mode
OPT	optical track
OT	optical track; on track; on target
OTC	on-track mode
P	plunge mode; paramp
P/A	passive/active
PL	plunge mode
PMRF	Pacific Missile Range Facility, Kauai, HI
PO	paramp
pps	pulses per second
PS	position scale
PT	plus time
PW	pulse width
Q	quality
R	radiation; range
RA	radiation
RAE	range, azimuth, elevation
REF	refraction
RF	refraction
RF	RF limit
RI	refraction
RO	radiation
R/T	real test
SB	skin beacon; skin track/ beacon track
SCP	position data scale
SCV	velocity data scale
SD	star data
sec	second
SIC	satellite ID code
SL	single
SS	sensor switch

sync	synchronization
T	track; transit
TOD	time of day
TR	on-track; track mode
TSPI	time space position information
usec	microsecond
UTC	universal time coordinated
UTTR	Utah Test and Training Range, Hill AFB, UT
V0, V1, V2	vehicle number
VD	valid data
VS	velocity scale
WR	Western Range
WSMR	White Sands Missile Range, White Sands, NM
XYZ	x-axis, y-axis, z-axis
yd	yard

PURPOSE

This document is a compilation of the responses to the Interrange Tracking Data Transmission Questionnaire sent to the ranges listed in figure 1. The questionnaire requested that each range check their compliance with IRIG Standard 161-85, IRIG Standard Data Format for Interrange Transmission of Tracking Data from Computer to Computer (2400 BPS Synchronous EFG Format 0). Currently, there are a total of 9 formats and 11 format subdivisions for interrange transmission of real-time tracking data from a computer on one range to a computer on another range. Figure 1 is a matrix of the formats and format users (i.e., ranges) which illustrates range-to-range real-time time space position information (TSPI) data links.

APPLICATIONS

The formats defined in this document are used by the national and service ranges for interchange of data. The classification of the formats is based on the degree of difference between the standard Format 0 and each format received from the ranges in response to the questionnaire. These dissimilitudes consist of bit coding variations as well as characteristic variations among the formats. Also, the nomenclature of the formats does not necessarily represent their technical reference identification when used by their respective range.

LIMITATIONS

The formats, with the exception of Formats 7 and 9, consist of 8 words, each containing 30 bits, for a total of 240 bits per frame. The frame rate is 10 frames per second. The formats have different coordinate systems; i.e., EFG geocentric, XYZ tangent plane, and RAE polar. Therefore, in order to accomplish a successful communication between ranges, some conventions must be observed.

COORDINATE SYSTEM DEFINITIONS

EFG

Geocentric Coordinate System. Orientation of system axis is system origin is at the geocenter, positive E-axis extends from origin through Greenwich meridian at the equator, positive F-axis extends from origin through 90-degree E meridian at the equator, and positive G-axis extends from origin through the North Pole.

XYZ

Rectangular Coordinate System. It is topocentric and Earth-fixed. Orientation of system axis is positive x-axis extends from origin to East, positive y-axis extends from origin to North, and positive z-axis extends from origin going up.

RAE

Polar Coordinate System. It is topocentric and Earth-fixed. Orientation of system axis is azimuth zero is true North with units increasing in a clockwise direction, elevation is horizontal with units increasing in an upward direction, and range zero is at the origin with increasing range away from the origin.

Matrix of Formats and Format Users

To / From	30 SW Vandenburg	45 SW Patrick	AAC Eglin	AFFTC Edwards	AWC Tyndall	EPG Arizona	KaenaPt Oahu,HI	KMR Kwajalein	NASA	NAWCAD PaxRiver	NAWDWDcl China Lake	NAWCWDpm Point Mugu	PMRF Kauai,HI	UTTR Utah	WSMR NewMexico
30SW	1A	1A/2B		1A			1A/2B		0C			1A			
45SW	1A/2B	1C				0A			9				2A		0A
AAC															
AFFTC	1B	1B							4		4/4A	1B		4	
AWC			7												
EPG									3						5/6
KaenaPt	1A/2B							2B							
KMR							0B/2B	0/0B	0B				0/0B/2B		
NASA	0C	8/9		4									0C		
NAWCAD															
NAWCWDcl				4											
NAWCWDpm	1/1A			1											
PMRF	2C	2					2C	0/2C	0C				2C		
UTTR				4											
WSMR		3/3A				5/6									

Figure 1. Range to Range Real-Time TSPI Data Links.

30 SW	30th Space Wing, Vandenburg AFB, CA
45 SW	45th Space Wing, Patrick AFB, FL
AAC	Air Armament Center, Eglin AFB, FL
AFFTC	Air Force Flight Test Center, Edwards AFB, CA
AWC	Air Warfare Center, Tyndall AFB, FL
EPG	Electronic Proving Ground, Ft. Huachuca, AZ
Kaena Pt.	Kaena Point, Oahu, HI
KMR	Kwajalein Missile Range, Kwajalein Atoll, Pacific Ocean
NASA	National Aeronautics and Space Administration
NAWCAD	Naval Air Warfare Center Aircraft Division, Pax River, MD
NAWCWD(pm or cl)	Naval Air Warfare Center Weapons Division, Point Mugu, CA; and China Lake, CA
PMRF	Pacific Missile Range Facility, Kauai, HI
UTTR	Utah Test and Training Range, Hill AFB, UT
WSMR	White Sands Missile Range, White Sands, NM

FORMAT DEFINITIONS AND FIGURES

Format 0
IRIG 240-Bit Format (EFG)

This format is used for transmitting and receiving tracking data between PMRF and KMR, and internally within KMR (see figure 2).

Word 1		
	Bits 1-16	Test Number, LSB = Bit 1 This field will handle a test number up to 65535.
	Bits 17-25	Day of Year This field is used to identify the day of the year.
	Bits 26-30	Format Type: 00000
Word 2		
	Bits 31-34	Tenth of Second, MSB = Bit 34 = 800 msec
	Bits 35-51	Time of Day or Plus Time, LSB = Bit 35 = 1 sec This field tags the data in seconds and may be either time or plus time according to bit-to-bit 150.
	Bits 52-60	Site ID These 9 bits provide the Site ID.
Word 3		
	Bits 61-88	E-Pos., LSB = Bit 61 Value of E in meters. Bit 88 indicates the sign of E.
	Bits 89-90	Position Scale Factor (KMR always sends 00) 00 = 1 110 = 10**3 01 = 10 11 = 10**10
Word 4		(KMR max absolute value of F is (2**27) - 1)
	Bits 91-118	F-Pos., LSB = Bit 91 Value of F in meters. Bit 118 indicates the sign of F.
	Bits 119-120	Velocity Scale Factor 00 = 1 01 = 10
Word 5		(KMR max absolute value of G is (2**27) – 1)
	Bits 121-148	G-Pos., LSB = Bit 121 Value of G in meters. Bit 148 indicates the sign of G.
	Bits 149	Optical Track (KMR always sends 0) 1 = on-track
	Bit 150	Plus Time Flag (KMR always sends 0) 1 = if plus time rather than Zulu time
Word 6		
	Bits 151-165	F-Velocity (meters per second), LSB = Bit 151 Bit 165 indicates its sign.
	Bits 166-180	E-Velocity (meters per second), LSB = Bit 166 Bit 180 indicates its sign.

Word 7

Bit 181	Liftoff (KMR always sends 1) 1 = liftoff has occurred
Bit 182	Plunge Mode (KMR always sends 0) 1 = plunge
Bits 183-184	Pulse Width (KMR always sends 0) 0-1.0 usec 1-2.4 usec 2-5 usec 3-10 usec
Bit 185	Refraction (KMR always sends 1) 1 = in 0 = out
Bit 186	RF Limit (KMR always sends 0) 1 = in 0 = out
Bit 187	Paramp (KMR always sends 0) 1 = on 0 = off
Bit 188	Radiation (KMR always sends 1) 1 = on 0 = off
Bit 189	Single (KMR always sends 0) 1 = dual lo 0 = single lo
Bit 190	Skin/Beacon Mode 1 = beacon 0 = skin
Bit 191	Track Bit 1 = on 0 = off
Bit 192	Quality Bit 1 = good 0 = bad
Bit 193-195	Mode (KMR always sends 7 = active track; 1 = all others) 0 = manual 4 = on-axis powered flight 1 = auto track 5 = on-axis coast 2 = computer drive 6 = auto track coast 3 = on-axis orbital
Bits 196-210	G-Velocity (in meters per second), LSB = Bit 196 Bit 210 indicates its sign.

Word 8

Bits 211-218	Check Sum
Bits 219-224	Spares Can be used for the target signal-to-noise level, 0 to 63 dB (LSB = 1 dB = Bit 219)
Bits 225-240	Sync Bits 0001101000011010: This pattern occurs on one message. 0001101000000101: This pattern occurs on next.

Check Sum Calculation

1. The first 210 data bits are treated as 14 words of 15 bits each. These words are summed (treating them as positive integers) in an accumulator capable of handling a 19-bit positive integer sum.
2. This sum is split into three parts; the most significant 7 bits, the next most significant 6 bits, and the least significant 6 bits. Three words are summed (treating them as positive integers) in an accumulator capable of handling an 8-bit positive integer sum.
3. This sum becomes the check sum.

> **NOTE**
>
> All fields are binary except where noted. Sign convention is two's complement. Day of Year, Test Number, and Check Sum may either be valid or zero.

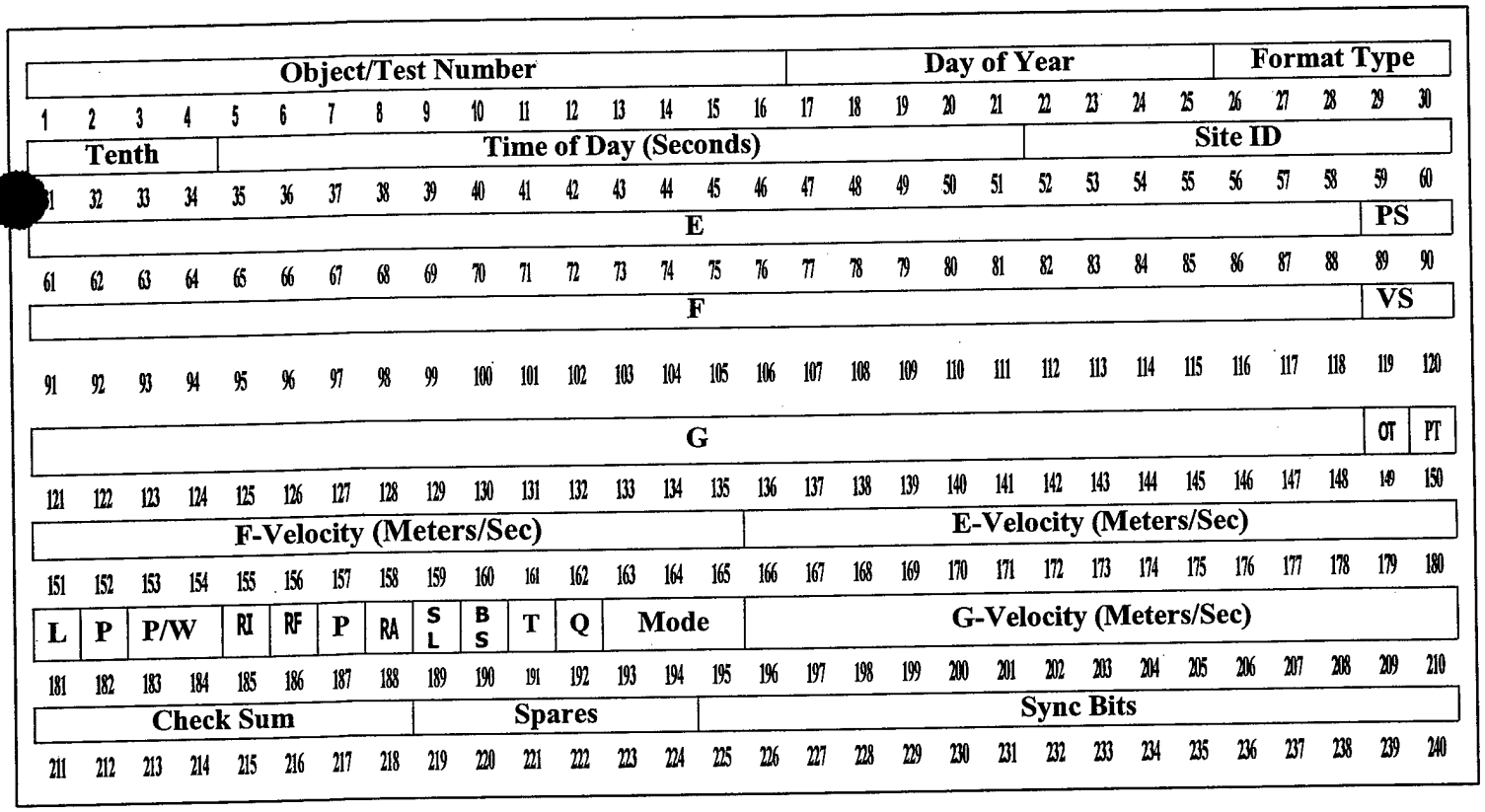


Figure 2. IRIG 240-Bit (KMR, PMRF, and ARGUS Aircraft Data) Format 0.

Format 0A
IRIG 240-Bit Format (EFG)

This format is used for transmitting from 45 SW to WSMR, EPG (Ft. Hauchuca), Bermuda, Wallops Island, and Korou (see figure 3). This format is the same as Format 0 except for the following:

Word 1

Bits 1-17	Object/Test Number, LSB = Bit 1 This field is now composed of 17 bits.
Bits 18-26	Day of Year, LSB = Bit 18 This field is reduced to 9 bits.
Bits 27-30	Format Type, LSB = Bit 27 This field is reduced to 4 bits.

Word 8

Bits 211-217	Check Sum This field is reduced to 7 bits.
Bits 218-224	Spares This field is now composed of 7 bits.

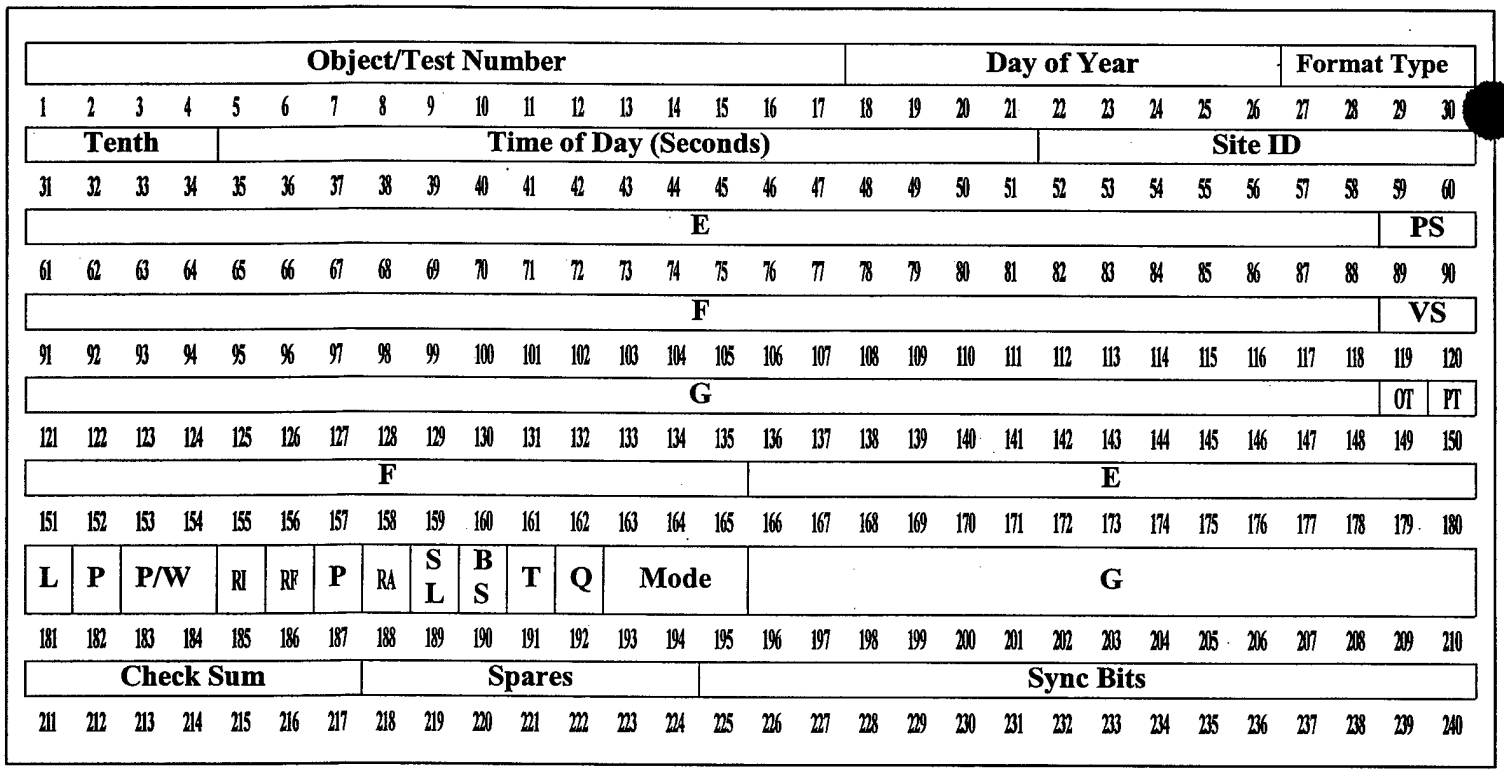


Figure 3. IRIG 240-Bit (ETR) Format 0A.

Format 0B
IRIG 240-Bit Format (EFG)

This format is used for transmission only of tracking data from KMR to NASA, PMRF, and Kaena Point. It is also used to transmit internally within KMR (see figure 4). Format 0B is the same as Format 0 except for the following:

Word 1

Bits 1-3 Objective Code

Bits 4-16 Spare

Word 2

Bits 31-34 Tenth is not used

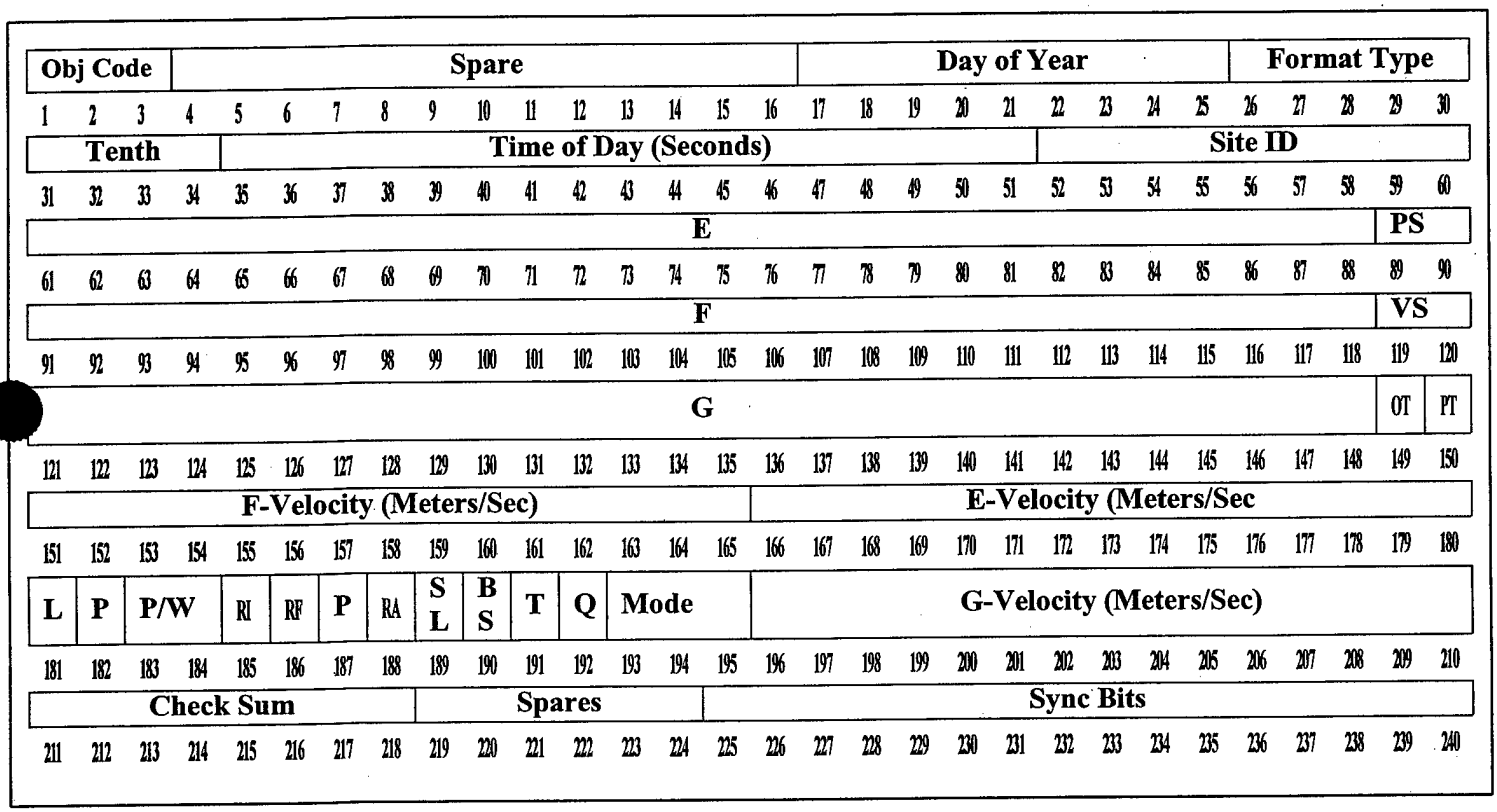


Figure 4. IRIG 240-Bit (ETR) Format 0B.

Format 0C
IRIG 240-Bit Format (EFG)

This format is used for transmitting and receiving data between PMRF and NASA, and between 30 SW and NASA Goddard (see figure 5). This format is the same as Format 0 except for the following:

Word 1

Bits 1-13	Satellite ID Code
Bits 14-17	Vehicle ID

Word 2

Bits 31-34	Tenth is not used

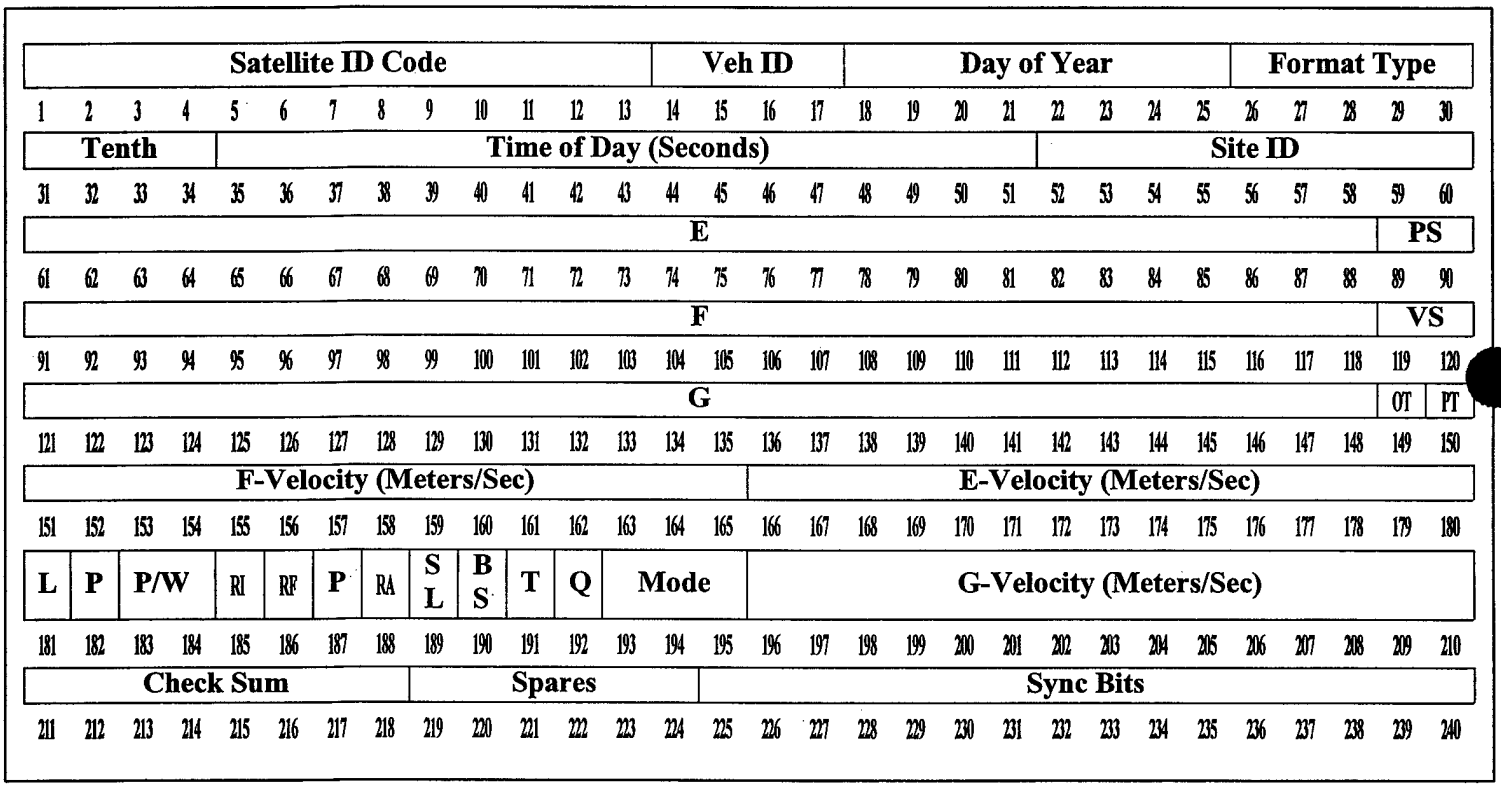


Figure 5. IRIG 240-Bit (NASA LTAS) Format 0C.

Format 1
IRIG 240-Bit Format (RAE)

This format is used for the transmission of time space position information (TSPI) and acquisition data from NAWCWD (Point Mugu) to 30 SW, and AFFTC (see figure 6).

Word 1		
	Bits 1-9	CRC Error Check (cyclic redundancy code) This field is the error detection for the previous frame (binary).
	Bit 10-16	Frame Sync Synchronization code is complemented every other frame. Master sync. has the bit pattern 1110010. It is maintained at 1 pps.
	Bits 17-23	Site ID, LSB = Bit 17 These 7 bits provide the Site ID.
	Bit 24	On Track 1 = on track 0 = off
	Bit 25	0
	Bit 26	Skin/Beacon 1 = skin track 0 = beacon track
	Bit 27	0
	Bits 28-29	(Classification) Spare For messages transmitted from NAWCWD (Point Mugu) Bit 28 = 1: Confidential; Bit 29 = 1: Secret
	Bit 30	0
Word 2		
	Bits 31-55	Range, LSB = Bit 31 Its value per bit varies from radar to radar (yards)
	Bits 56-60	Azimuth Angle, MSB = Bit 74 MSB = 180 degrees. Each descending order bit is equal to one half the value of the previous bit. Lower order bits are zeroed depending on the resolution of the angle.
Word 3		
	Bits 61-74	Azimuth (continuation)
	Bits 75-90	Elevation Angle, MSB = Bit 93 MSB = 180 degrees. Each descending order bit is equal to one half of the previous bit.
Word 4		
	Bits 91-93	Elevation (continuation)
	Bits 94-114	Range Rate, LSB = Bit 94 Twenty-one bits of Doppler format (yards/sec)
	Bits 115-120	Expansion (options)

Word 5

Bits 121-123	Events
Bits 124-129	Time Vernier, MSB = Bit 129 MSB = 800 msec
Bits 130-133	Auxiliary Data
Bits 134-150	Time of Day, LSB = Bit 134 LSB = 1 sec

Words 6, 7, and 8 (Bits 151-240) are the same as Words 2, 3, and 4 (Bits 31-120), respectively.

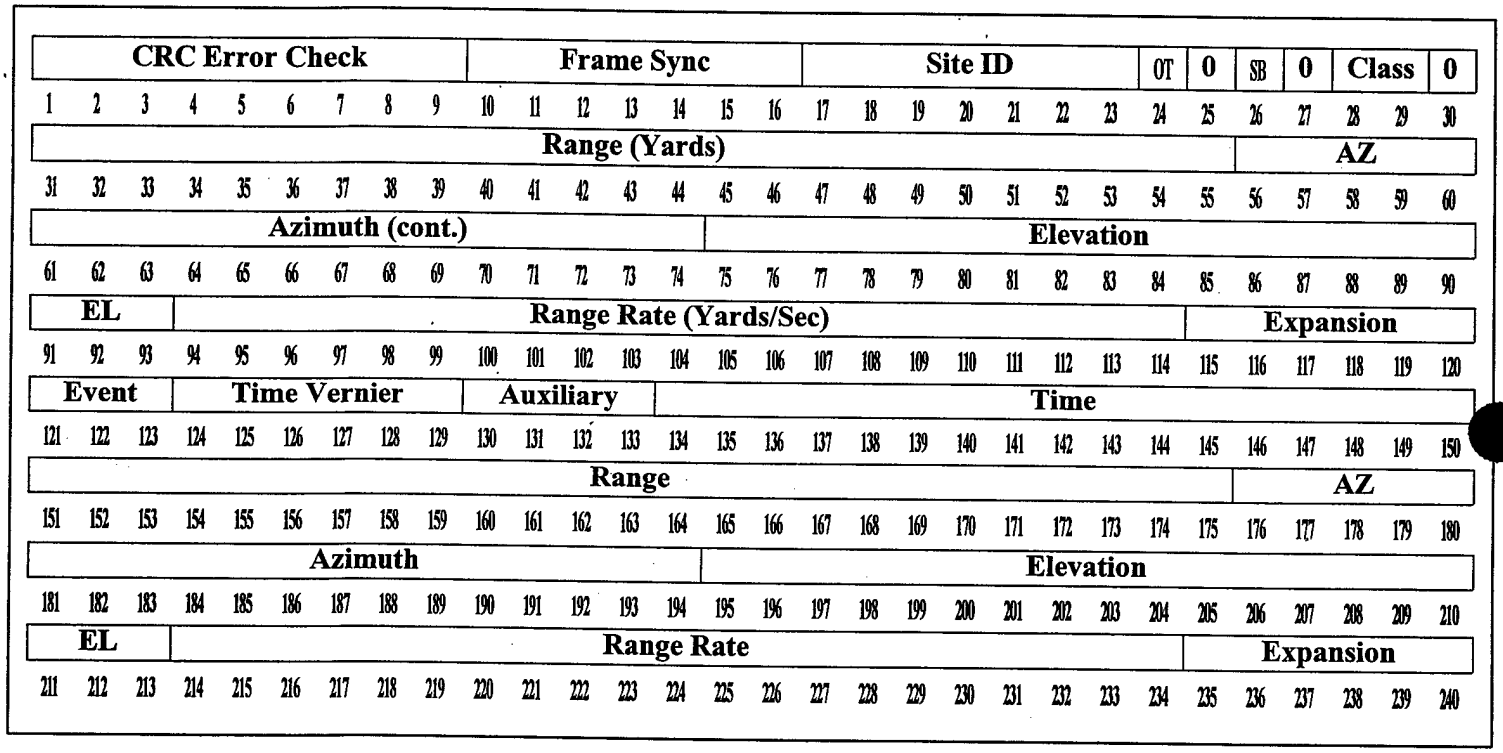


Figure 6. IRIG 240-Bit (NAWCWD Point Mugu) Format 1.

Format 1A
IRIG 240-Bit Format (RAE)

This format is used for the transmission of data from 30 SW to AFFTC, and for transmitting and receiving data between NAWCWD (Point Mugu) and 30 SW, between 30 SW and 45 SW, and between 30 SW and Kaena Point. It is also used to transmit internally within 30 SW (see figure 7).

Word 1			
	Bits 1-9	CRC Error Check	
	Bits 10-16	Frame Sync	
	Bits 17-23	Site ID	
	Bit 24(OT)	1 = sensor on target	0 = sensor not on target
	Bit 25 (CT)	1 = coherent track	0 = not coherent track
	Bit 26 (SB)	1 = skin track	0 = beacon track
	Bit 27 (DQ)	1 = MIPIR good data quality	0 = no good quality
	Bit 28 (RF)	Refraction Correction Indicator	
	Bit 29 (T)	1 = transit correct	
	Bit 30 (SP)	unused	
Word 2			
	Bits 31-55	Range: LSB = 1.953125 yds, LSB = Bit 31	
	Bits 56-60	Azimuth: MSB = 180 degrees, MSB = Bit 74	
Word 3			
	Bits 61-74	Azimuth (cont.)	
	Bits 75-90	Elevation: MSB = 180 degrees, MSB = Bit 93	
Word 4			
	Bits 91-93	Elevation (cont.)	
	Bits 94-114	Range Rate	
		Bit 94: LSB = 0.03125 yd/sec	
		Bit 113: MSB = 1384 yd/sec	
		Bit 114: Sign 1 = decreasing range	0 = increasing
	Bits 115-117	Range Expansion (3 bits)	
		Bit 115: LSB = 0.244140625 yds	
	Bits 118-120	Range Rate Expansion	
		Bit 118: LSB = 0.00390625 yd/sec	
Word 5			
	Bits 121-122	Time Events (2 bits)	
		Bit 121: 1 = liftoff	
		Bit 122: 1 = sensor switch	
	Bits 123-129	Sample Time Vernier (7 bits)	
		Binary counter of fractions of seconds since last second.	
		Bit 123: LSB = 12.5 millisecs	
		Bit 129: MSB = 800 millisecs	

Bits 130-133	Auxiliary bits Unused but reserved
Bits 134-150	Sample Time Binary count of seconds universal time coordinated (UTC) Bit 134: LSB = 1 sec Bit 150: MSB = 65536 secs

Words 6, 7, and 8 (Bits 151 to 240) are the same as Words 2, 3, and 4 (Bits 31 to 120), respectively.

NOTE

The values for these bit weights are nominal for the 30 SW radar. Some radars from NAWCWD (Point Mugu) have different nominal values. Radars operating and transmitting 10-pps data shall have the respective data the same for 30 SW line Bits 31-114 and Bits 151-234. Radars operating and transmitting 20-pps data shall have Bits 31-114 associated with the Time Vernier, and data contained in 30 SW line Bits 151-234 shall be 50 milliseconds later.

CRC Error Check									Frame Sync							Site ID								OT	CT	SB	DQ	RF	T	SP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Range (Yards)																											AZ			
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Azimuth (cont.)														Elevation															
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
EL			Range Rate (Yards/Sec)																						Range		R. Rate			
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Evt.		Time Vernier							Auxiliary					Time															
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Range																											AZ		
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Azimuth														Elevation															
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
EL			Range Rate																						Range		R. Rate			
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 7. IRIG 240-Bit (SW 30) Format 1A.

Format 1B
IRIG 240-Bit Format (RAE)

This format is used for the transmission of data from AFFTC to NAWCWD (Point Mugu), 30 SW, and 45 SW (see figure 8). This format is the same as Format 1 except for the following:

Word 1

Bit 25 (CT)	1 = coherent track	0 = not coherent track
Bit 28 (OPT)	1 = optical track	0 = not optical track
Bit 29 (AO)	1 = azimuth override	0 = off
Bit 30 (EO)	1 = elevation override	0 = off

Word 4

Bits 115-117	Range
Bits 118-120	Range Rate

Word 5

Bits 121-122	Event	
	Bit 121 (LO): 1 = liftoff	0 = stand-by
	Bit 122 (SS): 1 = sensor switch	0 = off

Bits 27, 56, 57, 75, 76, 123, 176, 177, 195, 196 are not used (NU).

CRC Error Check									Frame Sync							Site ID								OT	CT	SB	NU	OPT	AO	EO
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Range (Yards)																									NU	NU	AZ		
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Azimuth														NU	NU	Elevation													
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
EL			Range Rate (Yards/Sec)																						Range		R. Rate		
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
LO	SS	NU	Time Vernier						Auxiliary							Time													
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Range																									NU	NU	AZ		
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Azimuth														NU	NU	Elevation													
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
EL			Range Rate																						Expansion				
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Figure 8. IRIG 240-Bit (RAE) Format 1B.

Format 1C
IRIG 240-Bit Format (RAE)

This format is used for transmitting and receiving shuttle landing data at 45 SW (see figure 9). Format 1C is the same as Format 1 except for the following:

Word 1

Bit 25 (CT)	1 = coherent track	0 = not coherent
Bit 27-30	Spare	

Word 5

Bit 130-132	Objective Number
Bit 133 (NU)	Not Used

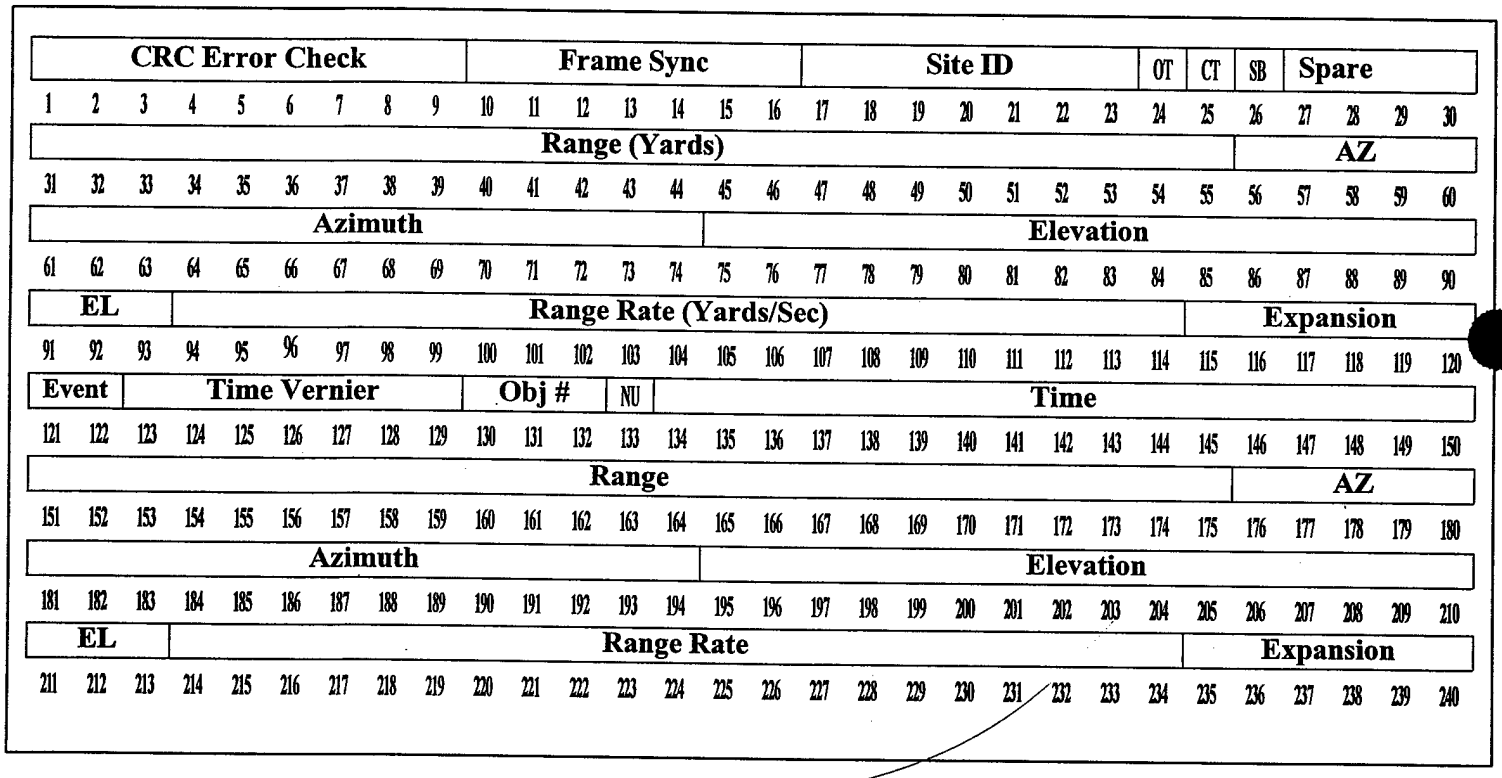


Figure 9. IRIG 240-Bit (Western Range) Format 1C.

Format 2
IRIG 240-Bit Format (EFG)

This format is used for the transmission of radar and acquisition data from PMRF to 45 SW (see figure 10). Format 2 is the same as Format 2C with the exception of the bit numbering.

Word 1

Bits 1-9	CRC Error Checking Cyclic redundancy code used for error detection
Bits 10-16	Frame Sync Seven bits on main synchronization code which complement every other frame. The master code is 1110010.
Bit 17 (P/A)	Passive/Active Flag 1 = active 0 = passive
Bit 18 (ST)	Not used
Bit 19 (OA)	On-Axis Mode
Bit 20 (TR)	On-Track Mode
Bit 21 (CD)	Computer Drive Mode
Bit 22 (SD)	Star Data Flag 1 = Star data 0 = Normal data
Bits 23-25	Vehicle Number (V0, V1, V2)
Bits 26-30	Sub Sync Complemented every other frame with a master code of 11010 in binary.

Word 2

Bits 31-60	E-axis: 30 bits of x-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 31

Word 3

Bits 61-90	F-axis: 30 bits of y-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 61

Word 4

Bits 91-120	G-axis: 30 bits of z-geodetic position. Two's complement negative number. LSB weighting depends on SCP bits (feet). LSB = Bit 91

Word 5

Bits 121-130	Time Vernier LSB = 1 milliseconds = Bit 121
Bits 131-147	Time Seventeen bits of GMT time LSB = 1 second = Bit 131
Bit 148	Not Used
Bit 149 (SB)	1 = beacon mode 0 = skin mode
Bit 150 (VD)	1 = valid data 0 = not valid

Word 6

Bits 151-166	E-Velocity Sixteen bits of x-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied (feet/sec). LSB = Bit 151
Bits 167-168 (SCV)	Velocity Data Scale 00 = LSB of 1 feet/sec 10 = Not used 01 = LSB of 10 feet/sec 11 = Not used
Bits 169-170 (SCP)	Position Data Scale 00 = LSB of 1 feet/sec 10 = LSB of 1000 feet/sec 01 = LSB of 10 feet/sec 11 = LSB of 10**20 feet/sec
Bits 171-180	BCD Day of Year, LSB = Bit 171 The day of the year as 3 binary coded decimal digits.

Word 7

Bits 181-196	F-Velocity, LSB = Bit 181 Sixteen bits of y-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied (feet/sec).
Bits 197-204	Site ID, LSB = Bit 197 The site identification of the data source. The FPQ-14 has a Site ID of 11100110 in binary. Any other site is ignored by real-time software. On data going to the FPQ-14, the PMRF BCD Site ID shall be used.
Bits 205-206	Spares: Not used, not reserved.
Bits 207-210	Fractional E-Velocity, LSB = Bit 207 Four bits of fractional x-velocity. LSB weighting depends on SCV bits. Appended to velocity before scale applied. This field reflects the sign convention control for the velocity field.

Word 8

Bits 211-226	G-Velocity, LSB = Bit 211 Sixteen bits of z-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Fractional velocity field appended to velocity field before LSB weighting factor applied.
Bits 227-232	1000 (1-B) FPQ-14 filter coefficient. 000000 = Perfect data. LSB = Bit 227
Bits 233-236	Fractional G-Velocity, LSB = Bit 233 Four bits of fractional z-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Appended to velocity data before scale factor applied. This field reflects the sign convention and control for the velocity field.

Bits 237-240 Fractional F-Velocity, LSB = Bit 237
Four bits of fractional y-velocity. Two's complement negative number. LSB weighting depends on SCV bits. Appended to velocity data before scale factor applied. This field reflects the sign convention and control for the velocity field.

NOTE

The on-track condition is determined by the following logic:
VD = 1 .And. R = 1 .Or. QA = 1

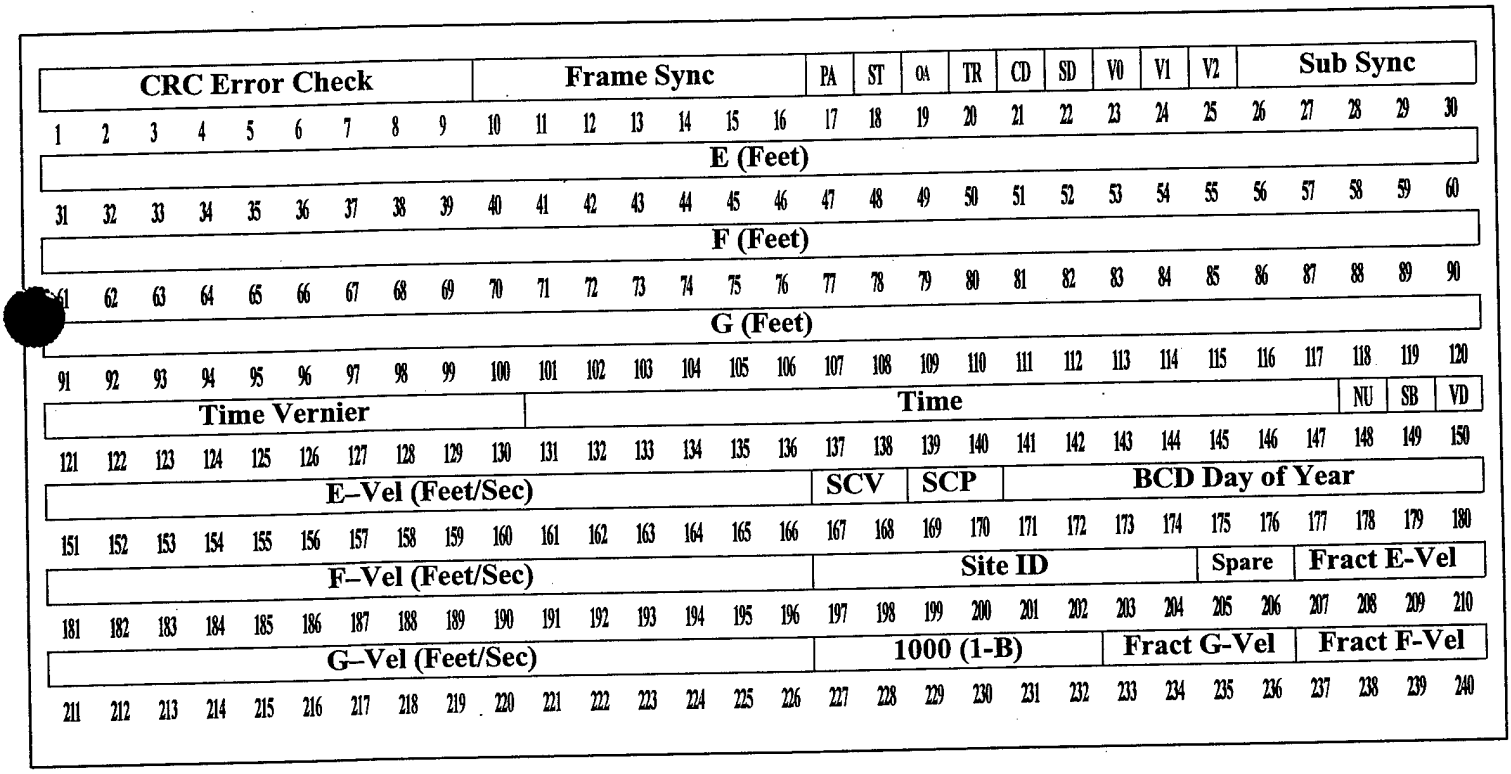


Figure 10. IRIG 240-Bit (PMRF) Format 2.

Format 2A
IRIG 240-Bit Format (EFG)

This format is used for the transmission of shuttle and special space test data from 45 SW to PMRF (Kauai) (see figure 11). Format 2A is the same as Format 2 except for the following:

Word 1

Bit 18	Spare (NU – not used)
Bit 20 (AT)	1 = Auto Track
Bits 26-30	Spare (Sub Sync is not used)

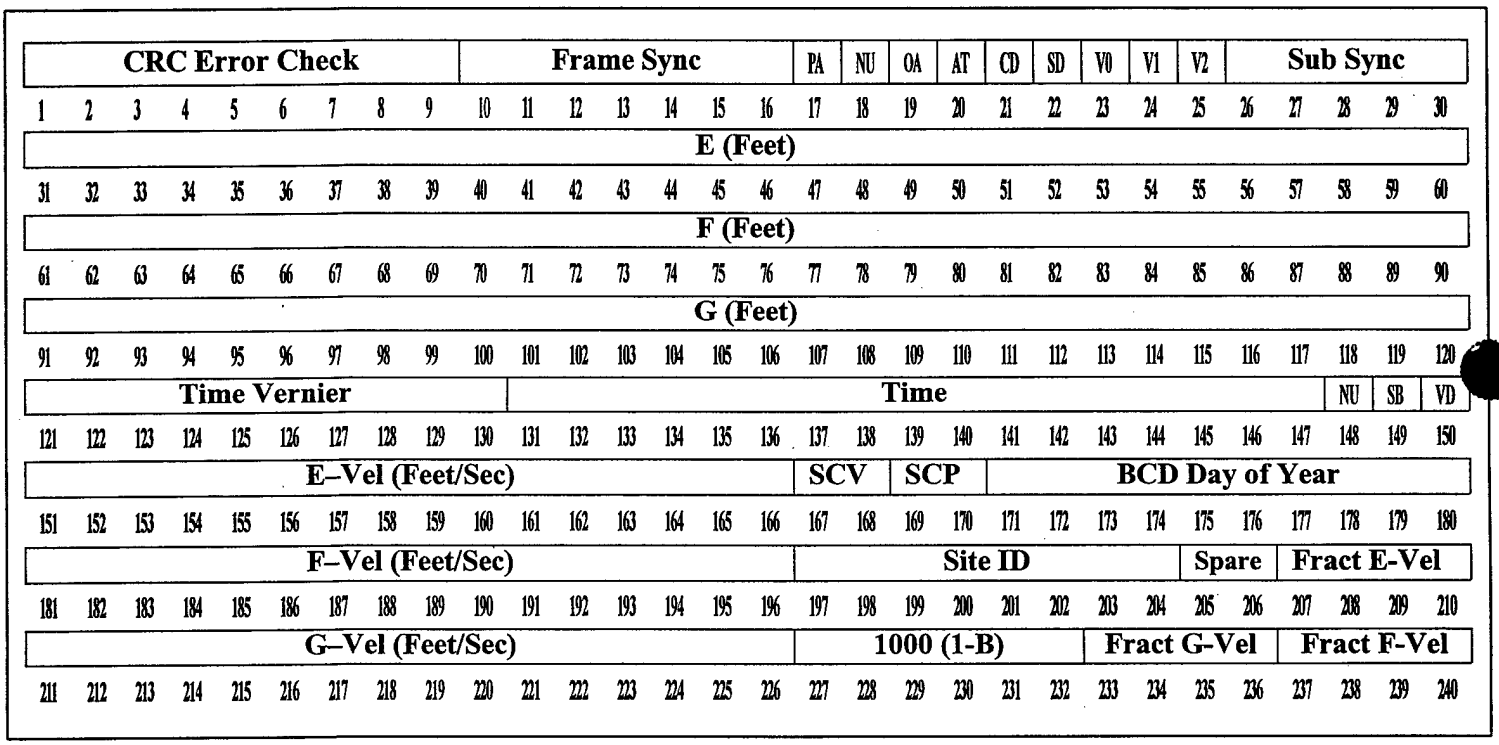


Figure 11. IRIG 240-Bit (Western Range) Format 2A.

Format 2B
IRIG 240-Bit Format (EFG)

Format 2B is used for transmitting and receiving radar and acquisition data between KMR and Kaena Point. It is also used for transmission from KMR to PMRF, and for post transmission and receipt of data between 30 SW and Kaena Point, and between 45 SW and 30 SW (see figure 12). Format 2B is the same as Format 2 except for the following:

Word 1

Bit 18 (DQ)	1 = good data quality
Bit 20 (AT)	1 = auto track
Bit 227-232	Spare

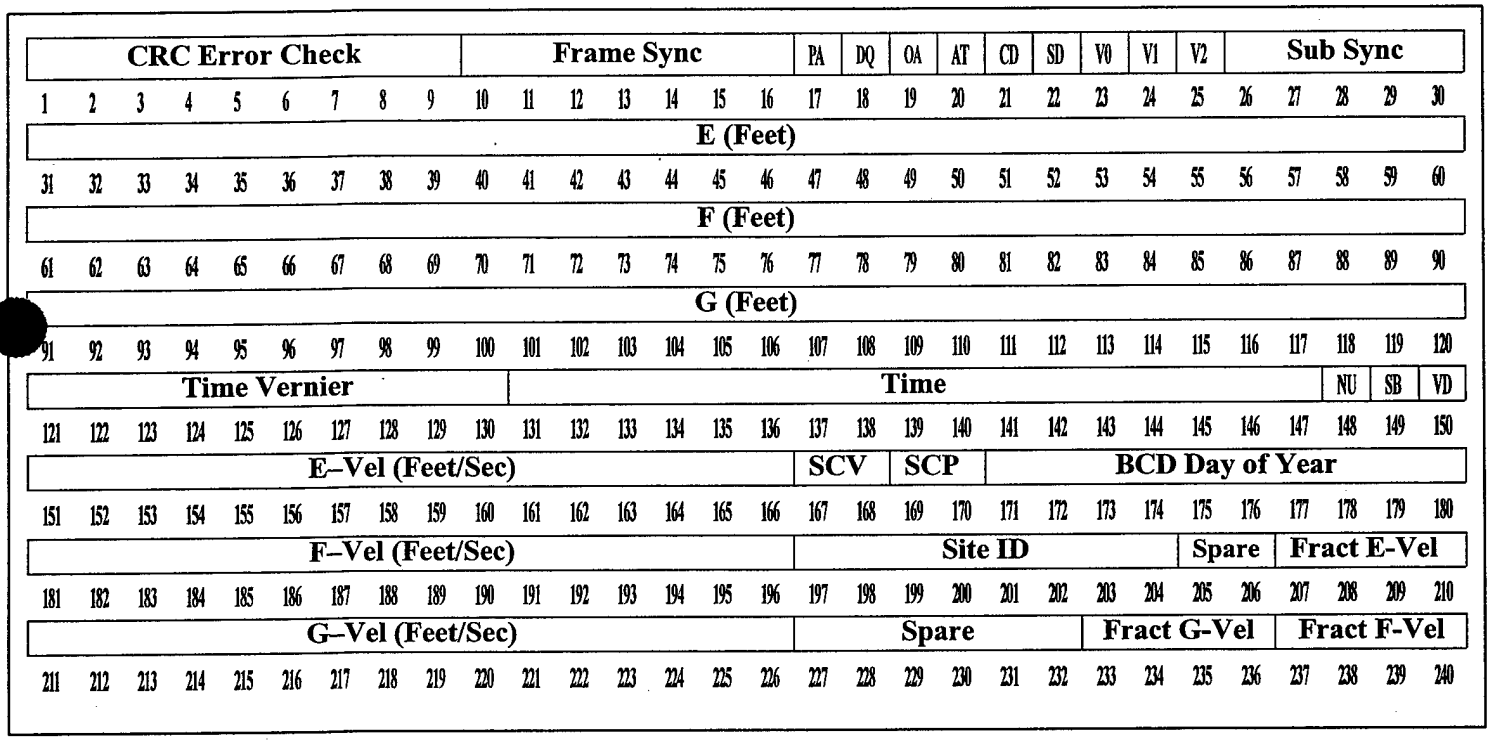


Figure 12. IRIG 240-Bit (Western Range) Format 2B.

Format 2C
IRIG 240-Bit Tracking Data for PMRF and KMR

This format is used by PMRF to transmit acquisition and metric tracking data to the Kaena Point FPQ-14 radar, the Air Force Kaena Point Satellite Tracking Facility, the Sandia Kauai Test Facility of PMRF, KMR, and 30 SW (see figure 13). Format 2C is the same as Format 2 with the exception of the bit numbering.

Word 1		
	Bits 1-7	Frame Sync; 1110010 complemented every other frame
	Bit 8	P/A; Passive/Active is 0 filled and not applicable for this application
	Bit 9	ST; only applicable for KMR
	Bit 10	OA; On-Axis Mode, not applicable for this application
	Bit 11	TR; Track Mode, only applicable for KMR
	Bit 12	CD; Computer Drive Mode, not applicable for this application
	Bit 13	SD; Star Data, not applicable for this application
	Bits 14-16	Vehicle body number
	Bits 17-21	Sub Sync; 11010 complemented every other frame
Word 2		
	Bits 22-51	E; E-Geocentric Position, two's complement negative, LSB = Bit 22
Word 3		
	Bits 52-81	F; F-Geocentric Position, two's complement negative, LSB = Bit 52
Word 4		
	Bits 82-111	G; G-Geocentric Position, two's complement negative, LSB = Bit 82
Word 5		
	Bits 112-138	UTC Time of Day in Seconds; Bits 112-121 in milliseconds, Bits 122-138 in seconds, LSB = Bit 112
	Bit 139	Spare
	Bit 140	SB; Skin Beacon
	Bit 141	VD; Valid Data
Word 6		
	Bits 142-157	E-Velocity; feet/second, two's complement negative, LSB = Bit 142
	Bits 158-159	SCV; Scale factors for velocity 00 - LSB is 1 ft/sec 01 - LSB is 10 ft/sec 10 - not used 11 - not used

Bits 160-161 SCP; Scale factors for position
00 - LSB is 1 ft
01 - LSB is 10 ft
10 - LSB is 10**3 ft
11 - LSB is 10**20 ft

Bits 162-171 BCD Day of Year, LSB = Bit 162

Word 7

Bits 172-187 F-Velocity; feet/second, two's complement negative, LSB = Bit 172

Bits 188-195 Site ID

Bits 196-197 Spare

Bits 198-201 Fractional E-Velocity; two's complement negative, LSB = Bit 198

Word 8

Bits 202-217 G-Velocity; feet/second, two's complement negative, LSB = Bit 202

Bits 218-223 1000(1-B); Filter Coefficient, not applicable, LSB = Bit 218

Bits 224-227 Fractional G-Velocity; two's complement negative, LSB = Bit 224

Bits 228-231 Fractional F-Velocity; two's complement negative, LSB = Bit 228

Bits 232-240 CRC Error Check; x**9+x**5+1

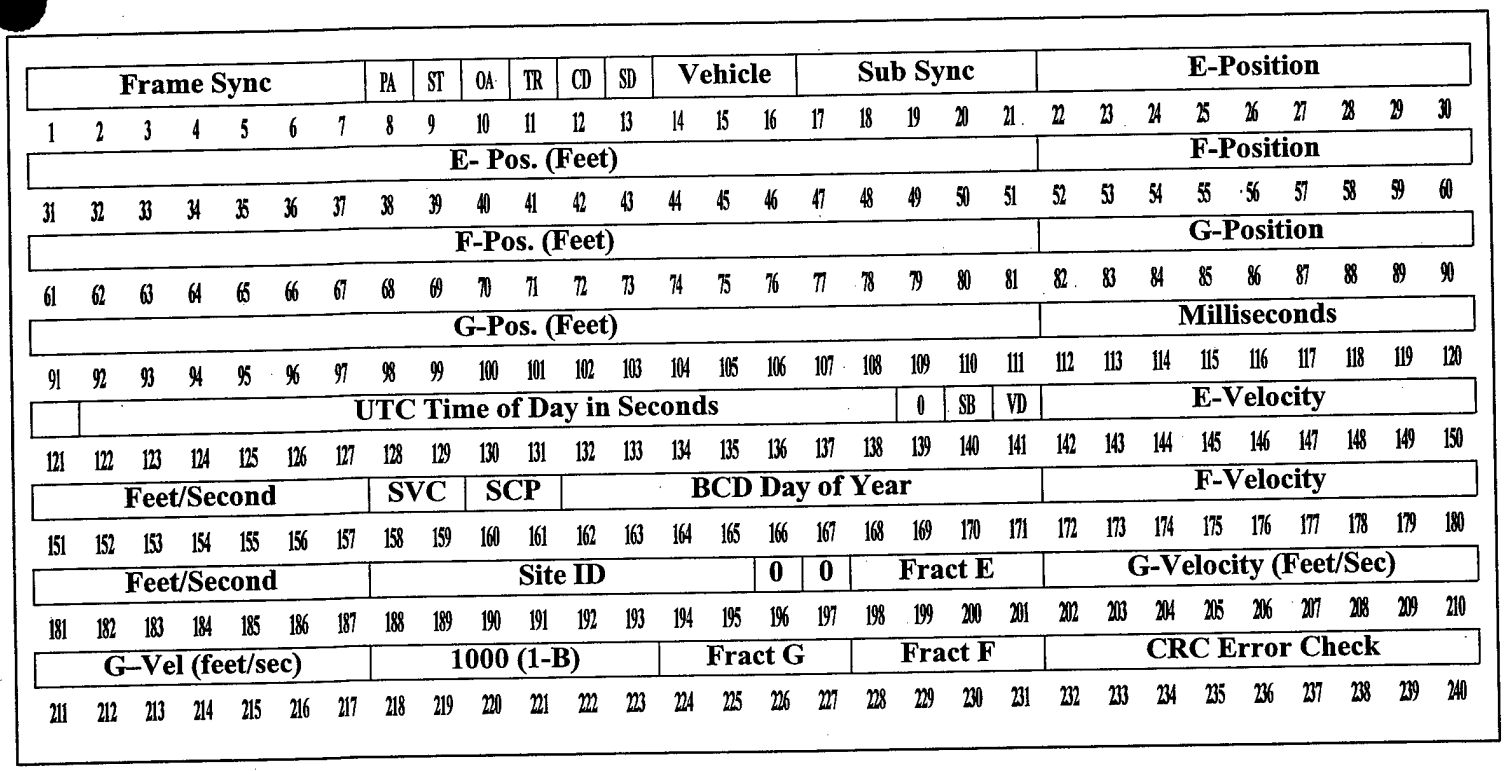


Figure 13. IRIG 240-Bit (PMRF Format Tracking Data, and KMR) Format 2C.

Format 3
IRIG 240-Bit Two-Radar Format (RAE or EFG)

This format is used for the transmission of shuttle data from EPG (Fort Huachuca, AZ) to NASA, and from WSMR to 45 SW (see figure 14).

Word 1		
	Bits 1-4	Tenth
	Bits 5-21	Time of Day (binary) first radar, LSB = Bit 5 = 1 sec
	Bits 22-30	Azimuth Seventeen bits of azimuth binary data first radar. LSB (Bit 24) is 0.0027465 degrees for all radars. MSB (Bit 40) is 180 degrees.
Word 2		
	Bits 31-40	Azimuth (cont.)
	Bits 41-59	Elevation Seventeen bits of elevation binary data first radar. Bit weighting is the same as for azimuth. MSB = Bit 59
	Bits 60 (B/S)	Beacon/Skin mode first radar 1 = beacon mode 0 = skin mode
Word 3		
	Bits 61-85	Range Twenty-four bits of range binary data first radar. LSB (Bit 61) is 1 yard for all radars.
	Bit 86 (OT)	Track bit first radar 1 = on-track
	Bit 87 (Q)	Quality bit first radar
	Bit 88-90	Radar Site ID, first radar, LSB = Bit 88
Word 4		
	Bits 91-96	Radar Site ID (cont.)
	Bits 97-104	WSMR Sync Code - 00010101
	Bits 105-113	Day of the Year - not used
	Bits 114-117	Format Type = 1101 assigned for two-radar format
	Bits 118-120	Spare
Word 5		The fields of Word 5 (Bits 121-150) are the same as for Word 1. Second radar data.
Word 6		The fields of Word 6 (Bits 151-180) are the same as for Word 2. Second radar data.
Word 7		The fields of Word 7 (Bits 181-210) are the same as for Word 3. Second radar data.
Word 8		
	Bits 211-216	Site ID Second Radar (cont.)
	Bits 217-224	WSMR Sync Code - 00001010
	Bits 225-240	Sync Code Alternate between the following patterns: 0101100001011000 on one frame and 1010000001011000 on the next.

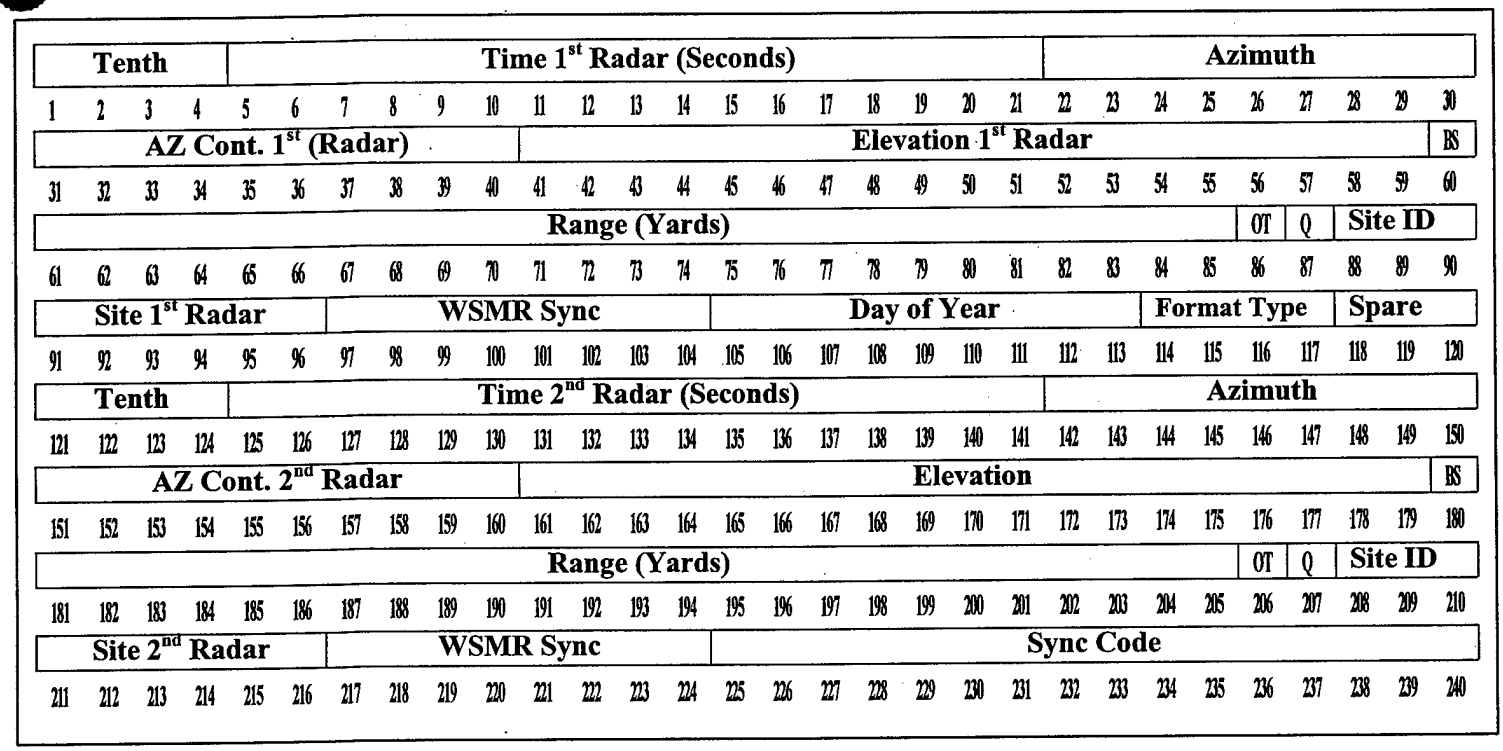


Figure 14. IRIG 240-Bit (Two Radar, NASA) Format 3.

Format 3A
IRIG 240-Bit Two Raw Data Radar Format (RAE)

This format is used for the transmission of shuttle landing data from WSMR to 45 SW (see figure 15).

It differs from Format 3 due to a variation in the following characteristics:

LSB weights:

Range 1.7859375 meters

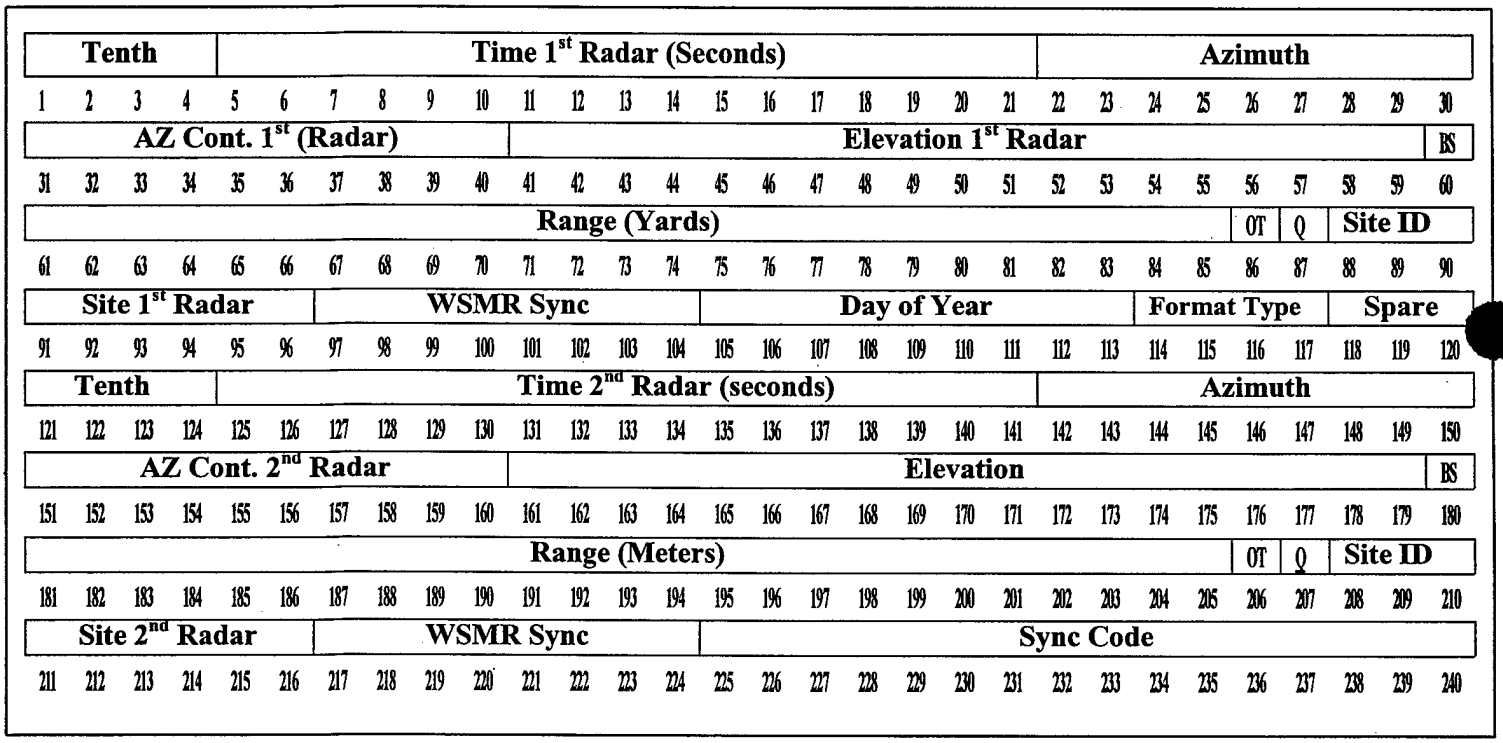


Figure 15. IRIG 240-Bit (Two Radar, ETR) Format 3A.

Format 4
IRIG 240-Bit Two Data Point Frame Format (RAE)

This format is used for transmitting and receiving data between AFFTC and NASA, between AFFTC and NAWCWD (China Lake), and between AFFTC and UTTR (see figure 16).

Word 1

Bits 1-9	Cycle Error Code: relate to previous frame
Bits 10-16	Frame Sync 1110010 and 0001101: code
Bits 17-23	Site Address
Bits 24-26	On-Track Mode - 1 (OTC-1)
	000 = manual 100 = auto-beacon
	001 = acquisition 101 = error
	010 = coast 110 = tiltmeter-slew
	(UTTR 110 = TV track)
	011 = auto-skin 111 = tiltmeter-static (UTTR 111 = cals)
Bits 27-30	Aux-1:
	Bit 27 1 = data polar coordinates
	0 = data Cartesian coordinates
	Polaris - range/azimuth/elevation
	Cartesian - X1 (East)/Y1 (North)/Z1 (up)
	Bits 28-29 00 = no refraction/no modeling
	01 = no modeling/refraction applied
	10 = modeling applied/no refraction
	11 = modeling applied/refraction applied
	Bit 30 1 = tone-on 0 = tone-off

Word 2

Bits 31-48	Aux-2: range rate If the radar produces range rate data, that data (16 bits sig magnitude LSB at Bits 31 or 151, LSB = 1/32 yd/sec) shall be present in Aux-2 & Aux-4 only when the on-track word has a value from 0 to 5.
Bits 49-60	Range (binary) LSB = Bit 49 = 1 ft (UTTR LSB = Bit 49 = 1 yd) X1 (East)

Word 3

Bits 61-72	Range (cont.)
Bits 73-90	Azimuth (BAMS), MSB = 180 degrees = Bit 96 LSB = Bit 73 = 1 ft Y1 (North)

Word 4

Bits 91-96	Azimuth (cont.)
Bits 97-120	Elevation (BAMS), MSB = 180 degrees = Bit 120 LSB = Bit 97 Z1 (up)

Word 5		
	Bits 121-123	OTC-2 On-Track Mode for second sample (1,2,...modes).
	Bits 124-133	Milliseconds Bit 124 LSB = 1 msec Bit 126 LSB = 4 msec
	Bits 134-150	TOD: Time of Day LSB = 1 sec (binary) = Bit 134
Word 6		The fields are the same as for Word 2 except for sample 2.
Word 7		The fields are the same as for Word 3 except for sample 2.
Word 8		The fields are the same as for Word 4 except for sample 2.

When data is transmitted to UTTR specifically, the localization is given by Cartesian coordinates. Therefore, the range, azimuth, and elevation fields are changed to x, y, and z fields, respectively.

Where x, y, and z: LSB = 1 foot
x2, y2, and z2: Later update of x, y, and z
x, y, and z: To be in sign magnitude data
MSB is sign bit: 0 = + 1 = -

Polar/Cartesian data: The first sample of the data frame shall be sampled at the time indicated by the milliseconds and time of day. The second sample shall be 50 milliseconds later. The entire frame of data shall be delayed by 100 milliseconds.

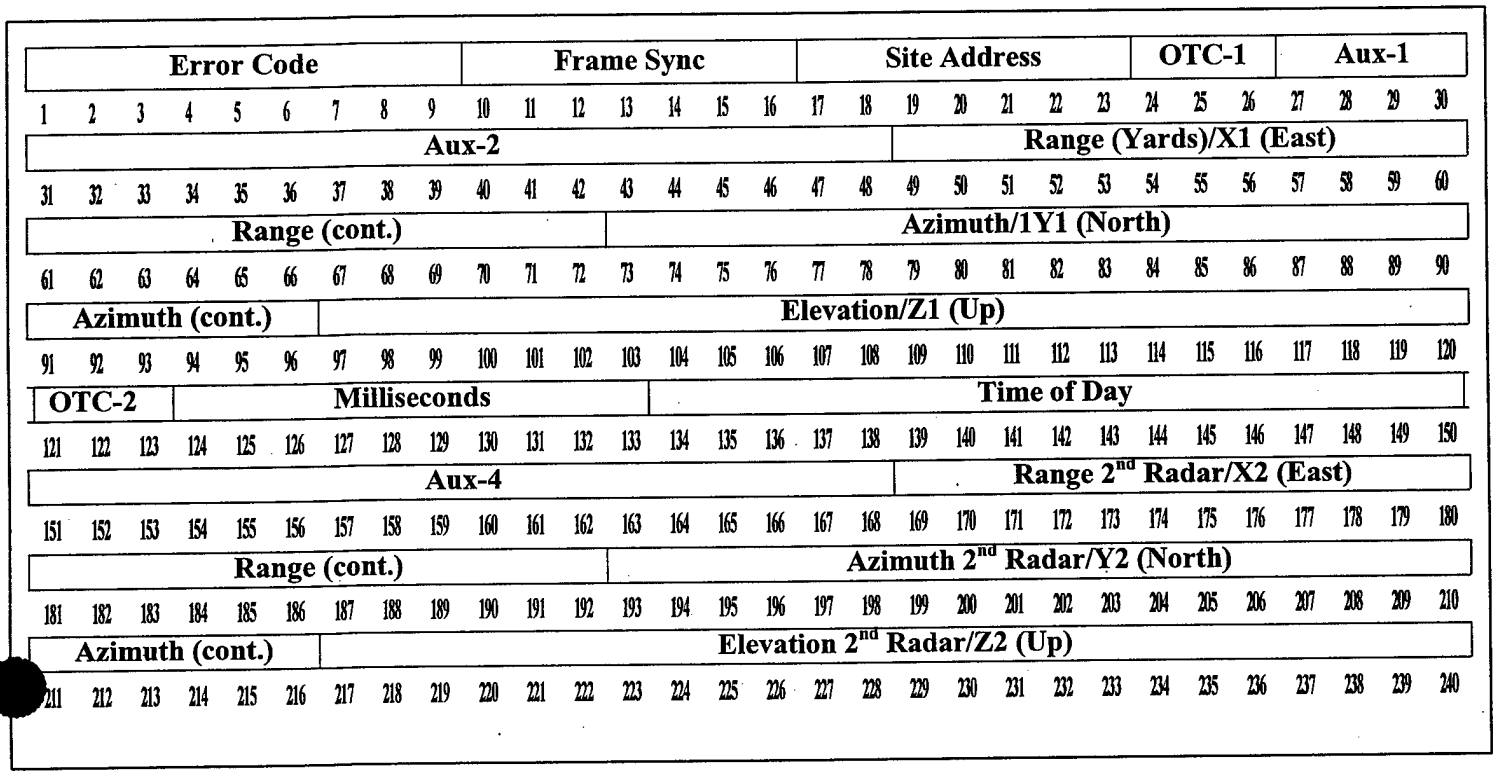


Figure 16. IRIG 240-Bit (Two Data Point Frame, AFFTC) Format 4.

Format 4A
IRIG 240-Bit Format (RAE)

This format is used for the transmission of TSPI data from AFFTC to NAWCWD (China Lake) (see figure 17). Format 4A is the same as Format 4 except for the following:

Word 1
- Bits 24-30 Aux-1

Word 5
- Bits 121-127 Aux-3
- Bits 128-133 Frame Count

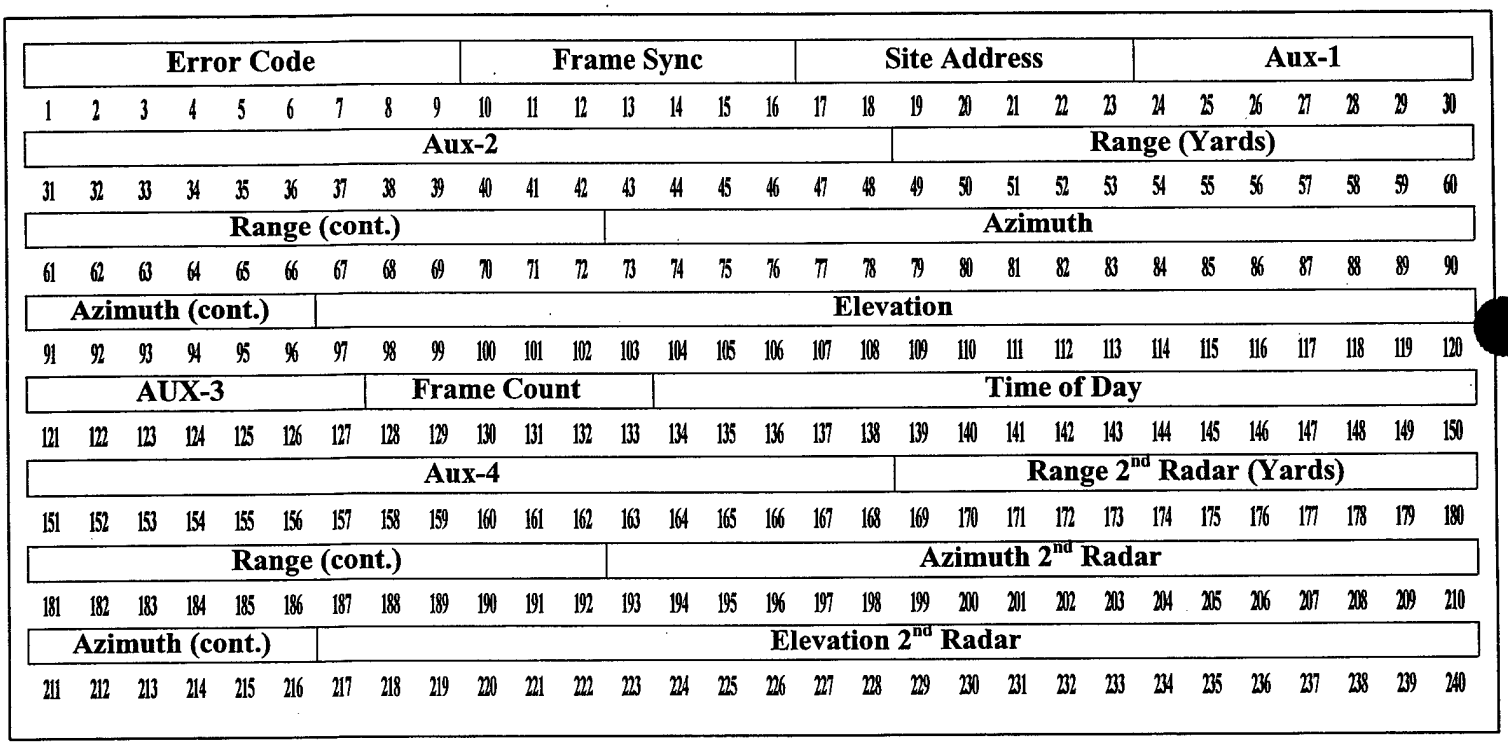


Figure 17. IRIG 240-Bit (Two Data Point Frame, China Lake) Format 4A.

Format 5
IRIG 240-Bit (ARDC) Format (RAE)

This format is used for transmitting and receiving shuttle data between EPG and WSMR (see figure 18).

Word 1		
	Bits 1-5	Sync Code: 11010 and 00101 It is alternately complemented.
	Bits 6-20	Auxiliary Auxiliary data switches. Bit numbers 18, 19, and 20 may also be used to indicate tracking mode in which Case 18 is manual skin, 19 is auto beacon, and 20 is auto skin.
	Bits 21-30	Range, LSB = Bit 21
Word 2		
	Bits 31-44	Range (cont.)
	Bits 45-46	Not Used
	Bits 47-60	Azimuth, MSB = 180 degrees = Bit 63
Word 3		
	Bits 61-63	Azimuth (cont.)
	Bit 64	Not Used
	Bit 65-81	Elevation, MSB = 180 degrees = Bit 81
	Bits 82-90	Site ID, LSB = Bit 82
Word 4		
	Bits 91-96	Site ID (cont.)
	Bits 97-113	Not Used
	Bits 114-120	Seconds, LSB = Bit 114 = 1 sec
Word 5		
	Bits 121-130	Seconds (cont.)
	Bits 131-140	Milliseconds, LSB = Bit 131 = 1 msec
	Bits 141-150	Range
Word 6		The fields of Word 6 are the same as for Word 2.
Word 7		The fields of Word 7 are the same as for Word 3.
Word 8		
	Bits 211-216	Site ID, LSB = Bit 211
	Bits 217-240	VS: Additional sync code for Vax radar interface unit.

A & E are MSB justified. If the radar source is less than 17 bit angles, the LSB is omitted from the word.

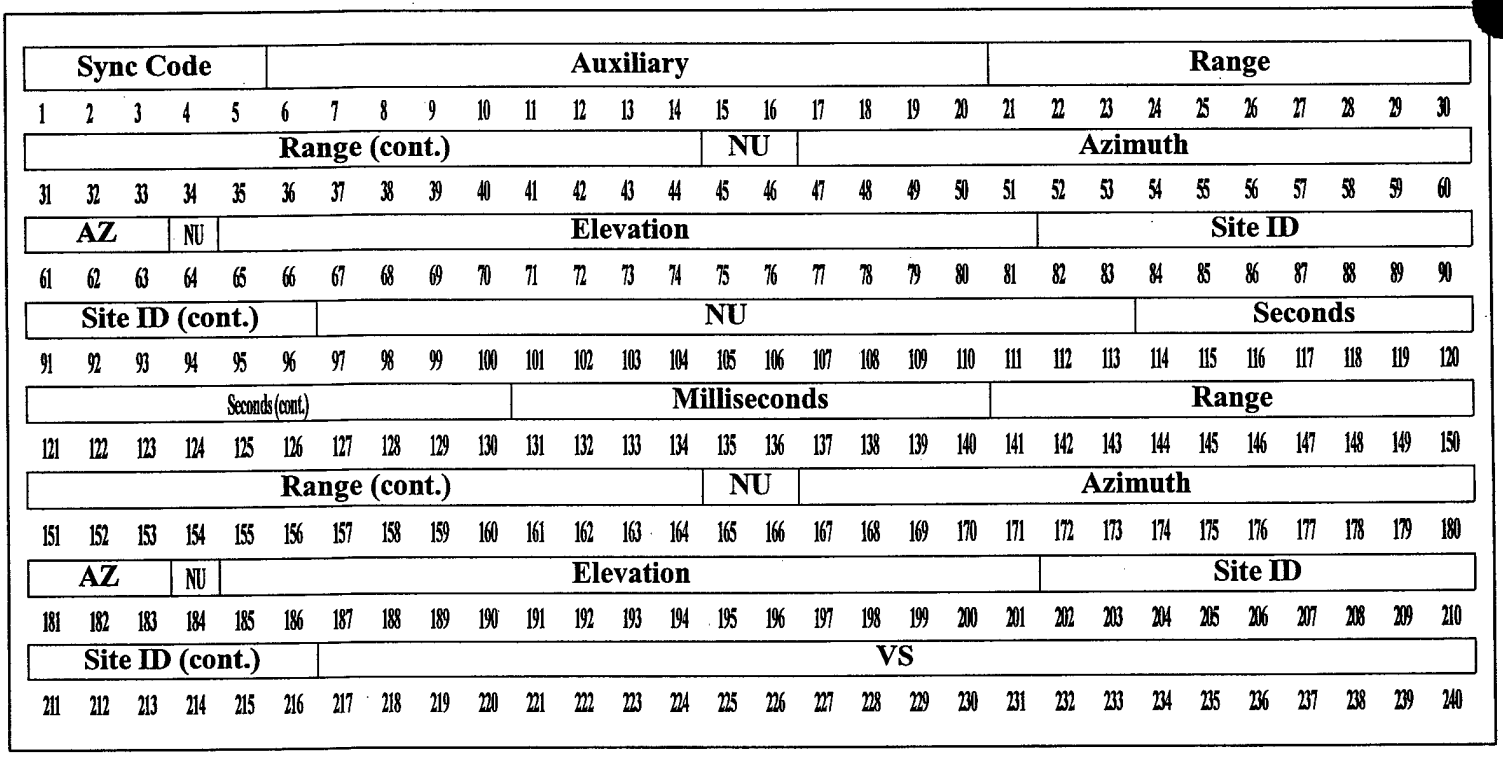


Figure 18. IRIG 240-Bit (ARDC, EPG) Format 5.

Format 6
IRIG 240-Bit Format (RAE)

This format is used for transmitting and receiving shuttle data between WSMR and EPG (Fort Huachuca, Mt. Lemon, Scott Peak, AZ) (see figure 19).

Word 1		
	Bits 1-5	Sync Code: 01010
	Bits 6-15	WSMR ID, LSB = Bit 6
	Bits 16-30	Arizona ID: Fixed 000000110100001
Word 2		
	Bits 31-39	Arizona ID (cont.) 101000000
	Bits 40-44	Site Sync 11010/00101
	Bits 45-53	Site ID, LSB = Bit 45
	Bits 54-55	Not Used
	Bit 56	Quality bit
	Bit 57 M/S	Manual (1)/Skin mode (2)
	Bit 58 A/B	Auto Beacon
	Bit 59 A/S	Auto Skin
	Bit 60	Range LSB = 1 yd = Bit 60
Word 3		
	Bits 61-83	Range (cont.)
	Bits 84-85	Not Used
	Bits 86-90	Azimuth MSB = 180 degrees = Bit 90
Word 4		
	Bits 91-102	Azimuth (cont.)
	Bit 103	Not Used
	Bits 104-120	Elevation MSB = 180 degrees = Bit 120
Word 5		
	Bits 121-125	Synchronization
	Bits 126-135	WSMR ID
	Bits 136-150	Not Used
Word 6		
	Bits 151-152	Not Used
	Bits 153-169	MST Time LSB = 1 second = Bit 153
	Bits 170-179	Time LSB=1 millisecond = Bit 170
	Bit 180	Range, LSB = Bit 180

Word 7

Bits 181-203	Range (cont.)
Bits 204-206	Not Used
Bits 207-210	Azimuth, MSB = 180 degrees = Bit 222

Word 8

Bits 211-222	Azimuth (cont.)
Bit 223	Not Used
Bits 224-240	Elevation, MSB = 180 degrees = Bit 240

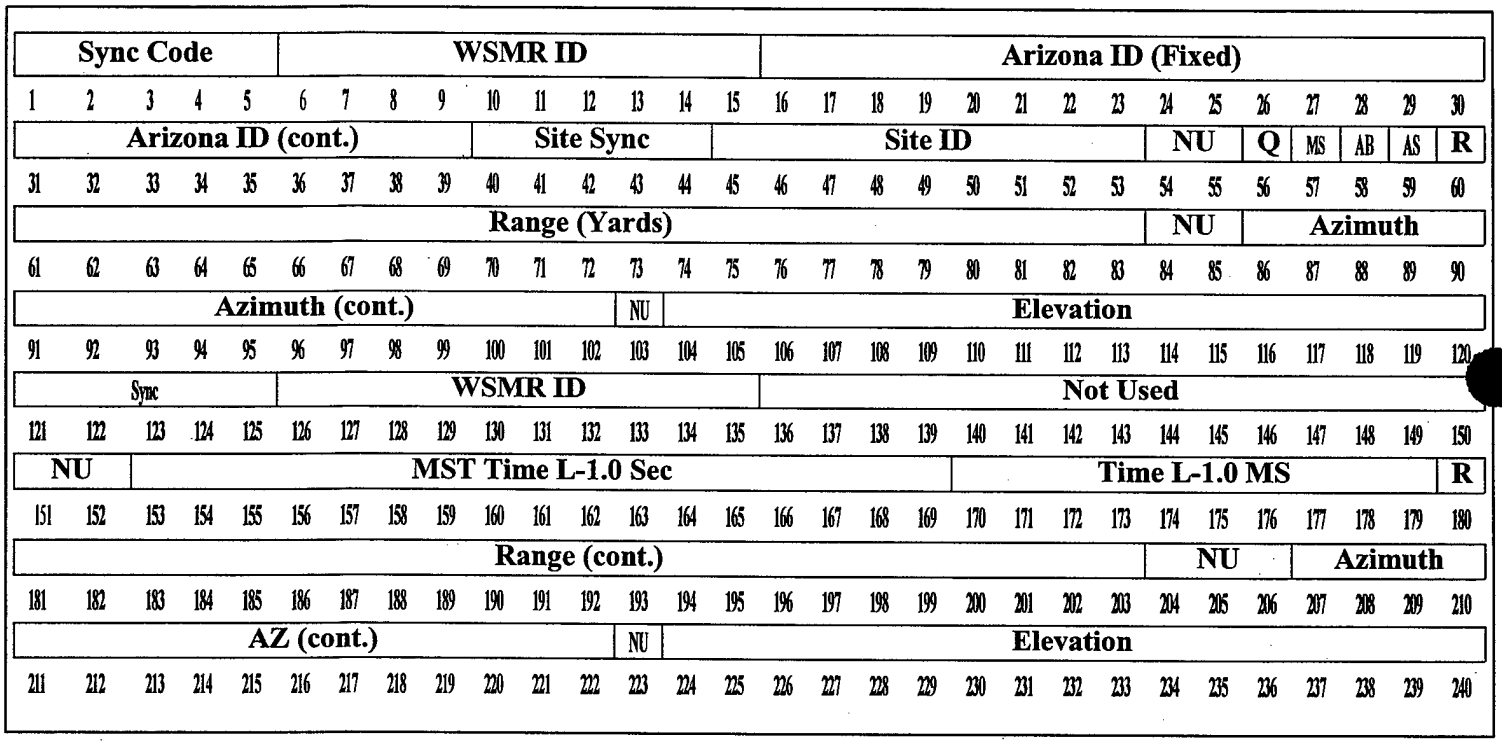


Figure 19. IRIG 240-Bit Format 6.

Format 7
IRIG 448-Bit (AWC) Format (XYZ)

This format is used for transmission from AWC Tyndall to AAC. The Tyndall Data System is formatted as a header of three 32-bit words followed by up to 20 target data blocks. Each target data block consists of eleven 32-bit data words. The buffer may therefore vary in length from three to 223 long words depending on how many target data blocks are included. Bit 1 is LSB for all words (see figure 20).

Word 1		Total # of 32-bit words in buffer (includes itself)
Word 2		Item Count
		Number of targets data block
Word 3		Status
		Status word (Bits 28-24 are set by SOS POP-11 on input)
	Bits 32-30	Not Used
	Bit 29	1 = short buffer
	Bit 28	1 = invalid word count
	Bit 27	1 = insufficient
	Bit 26	1 = data overrun error
	Bit 25	1 = microwave parity error
	Bits 24-23	Not Used
	Bits 22-21	Mission Status
		0 = not def 2 = simulated GRDCS data
		1 = live GRDCS data 3 = end of mission

Data block format is as follows (real time data system/characteristics):

Word 1	GRDCS name
Word 2	Record Number (tall number)
Word 3	Time Stamp (time tag for data, milliseconds, past midnight)
Word 4	X-Position: target x-pos, feet
Word 5	Y-Position: target y-pos, feet
Word 6	Z-Position: target z-pos, feet
Word 7	X-Velocity: target x-vel, feet/sec
Word 8	Y-Velocity: target y-vel, feet/sec
Word 9	Z-Velocity: target z-vel., feet/sec
Word 10	Quality

Word 11		FIT Status Downlinked FIT status word in lower 16 bits: upper 16 bits are zero. If target is not a FIT, entire word is zero.
	Bits 16-8	FIT address
	Bit 7	1 = error
	Bits 6-4	Battery voltage
	Bit 3	0 = safe separation
	Bits 2-1	1 = safe 3 = arm 2 = pre-arm 4 = fire

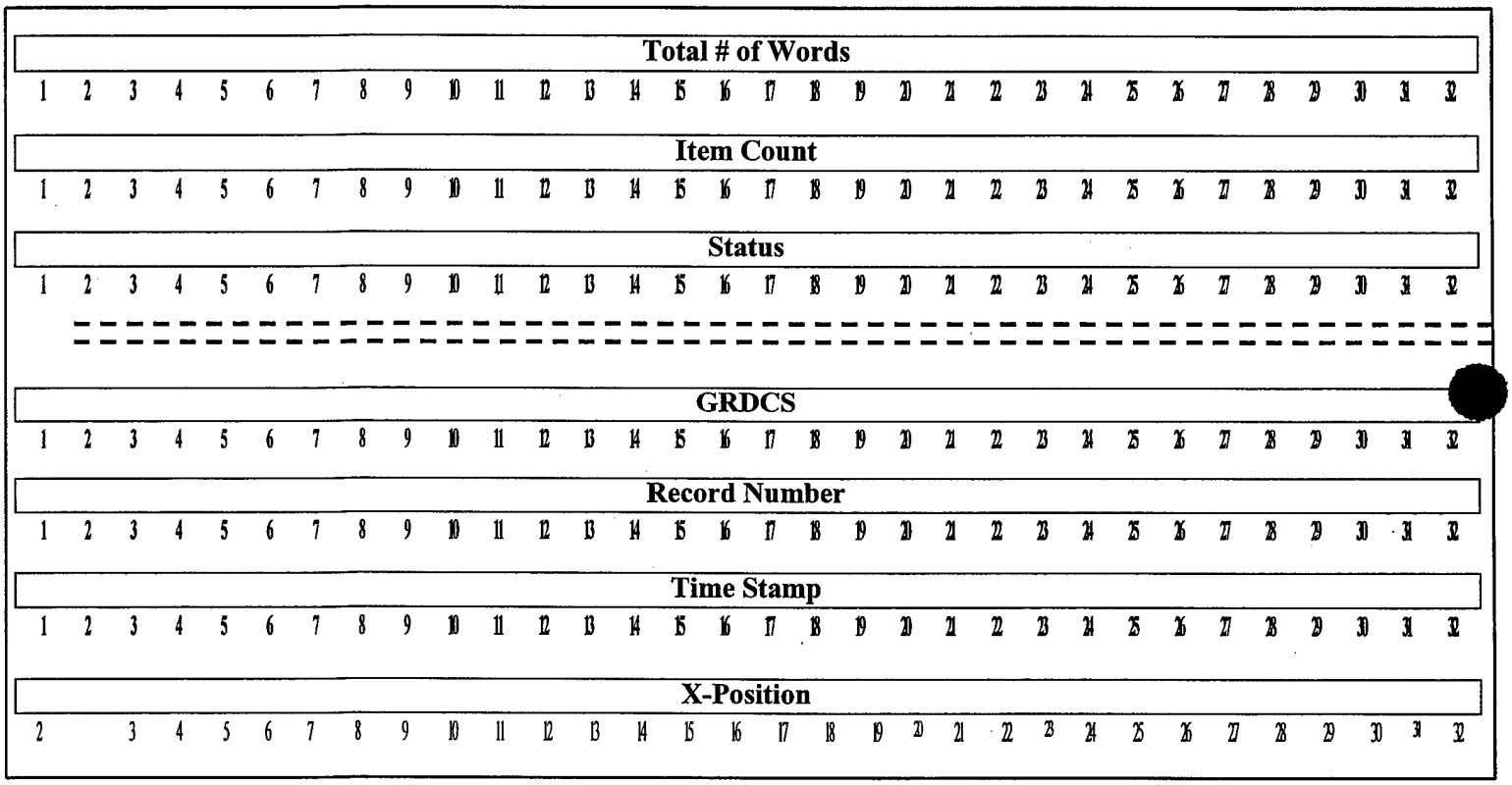


Figure 20. IRIG 448-Bit (AWC, Tyndall) Format 7.

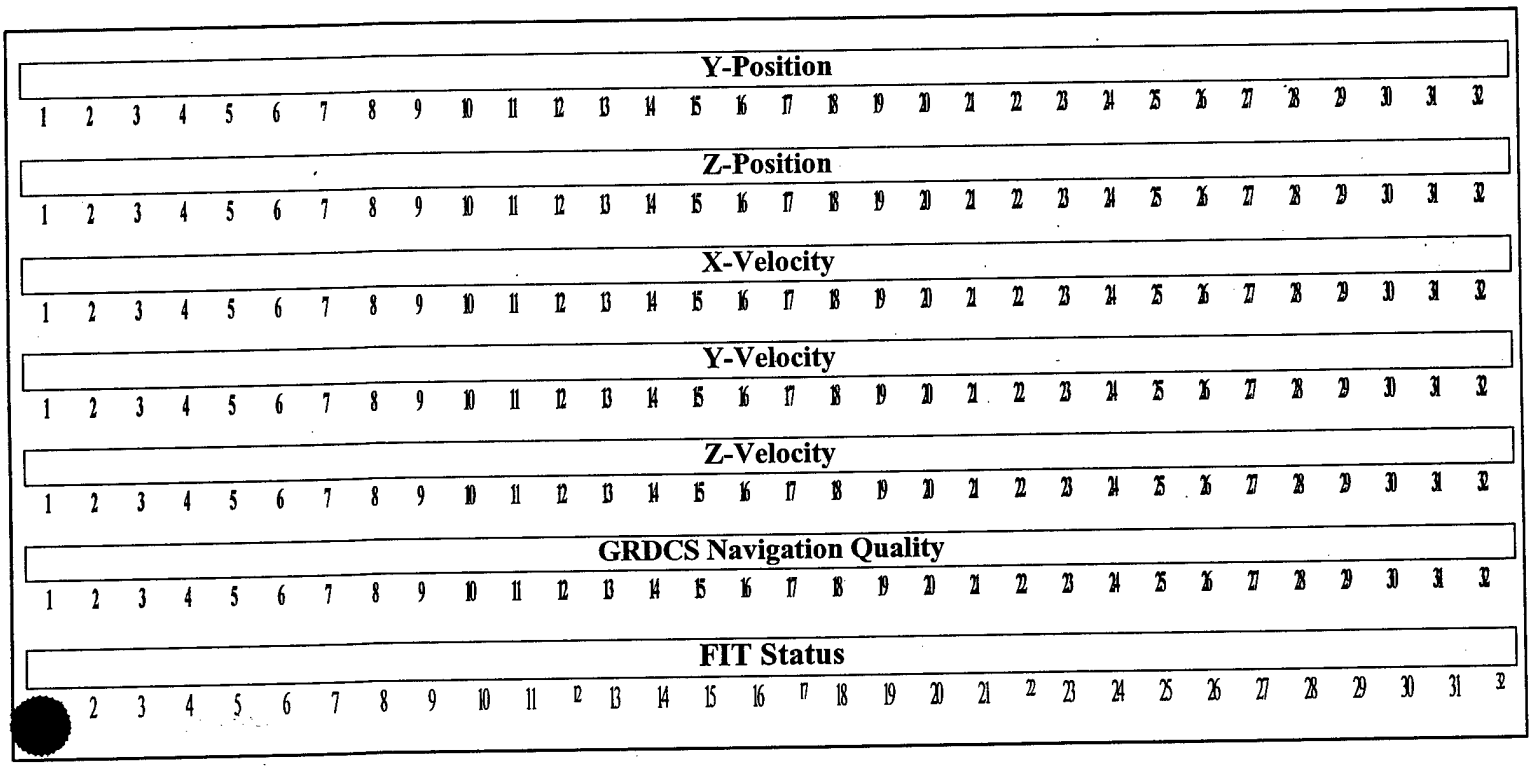


Figure 20. IRIG 448-Bit (AWC, Tyndall) Format 7 (cont.).

Format 8
IRIG 240-Bit (MDDF) Format (RAE)

This format is used for transmission of shuttle data from NASA radars to 45 SW (see figure 21).

Word 1		
	Bits 1-13	SIC (binary)
	Bits 14-17	Vehicle ID
	Bits 18-26	Day of Year (binary), LSB = Bit 18
	Bits 27-30	Format Type: 1110
Word 2		
	Bits 31-51	Time of Day (binary), LSB = Bit 31
	Bits 52-60	Site ID, LSB = Bit 52
Word 3		
	Bits 61-79	Azimuth: MSB = 180 degrees = Bit 79
	Bits 80-90	Elevation: MSB = 180 degrees = Bit 98
Word 4		
	Bits 91-98	Elevation (cont.)
	Bits 99-120	Range: LSB = 1.7859376 meters = Bit 99
Word 5		
	Bits 121-123	Range (cont.)
	Bits 124-150	Doppler (counts of 240 MHz + 1000 fd) LSB = 1 cycle = Bit 124
	Bits 151-171	Doppler (cont.)
	Bits 172-173	One-, Two- or Three-Way Data: 00 = 1-way 01 = 2-way 11 = 3-way
	Bit 174 (R/T)	Real/Test 1 = real data
	Bits 175-176	Geo (antenna geometry): 00 = AZ-EL 01 = (X-Y) (+X = South) 11 = (X-Y) (+X = East)
	Bits 177-180	Spares
Word 6		
	Bit 181 (L)	1 = Liftoff has occurred
	Bit 182 (P)	1 = Plunge
	Bits 183-184	(P/W) Pulse Width 00 = 1.0 microsec 01 = 2.4 microsec 10 = 5.0 microsec 11 = 10.0 microsec
	Bit 185 (RI)	Refraction Correction 0 = out 1 = in
	Bit 186 (DI)	Droop 0 = out 1 = in

Bit 187 (PO)	Paramp	
	0 = off	1 = on
Bit 188 (RO)	Radiation	
	0 = off	1 = on
Bit 189 (LO)	0 = single lo	1 = dual lo
Bit 190 (B/S)	Beacon/Skin	
	0 = skin	1 = beacon
Bit 191 (T)	Track	
	0 = off	1 = on
Bit 192 (Q)	Quality	
	0 = bad	1 = good
Bits 193-195	Mode	
	000 = manual	100 = on-axis powered flight
	001 = autotrack	101 = on-axis coast
	010 = computer drive	110 = autocoast
	011 = on-axis orbital	
Bit 196 (R)	Range	
	1 = range good	0 = range bad
Bit 197 (A)	Angle	
	1 = angles good	0 = angles bad
Bit 198 (DP)	Dop (Doppler)	
	1 = Doppler good	0 = Doppler bad
Bit 199 (DD)	Destruct Doppler	
	1 = destruct	
Bit 200 (LFI)	Last Frame Indicator	
	1 = last frame	
Bits 201-210	Polynomial Error Code, LSB = Bit 201	

Word 8

Bits 211-224	Polynomial (cont.)
Bits 225-240	Synchronization Bits (Bits 240-225) will have the following pattern: 0001101000011010

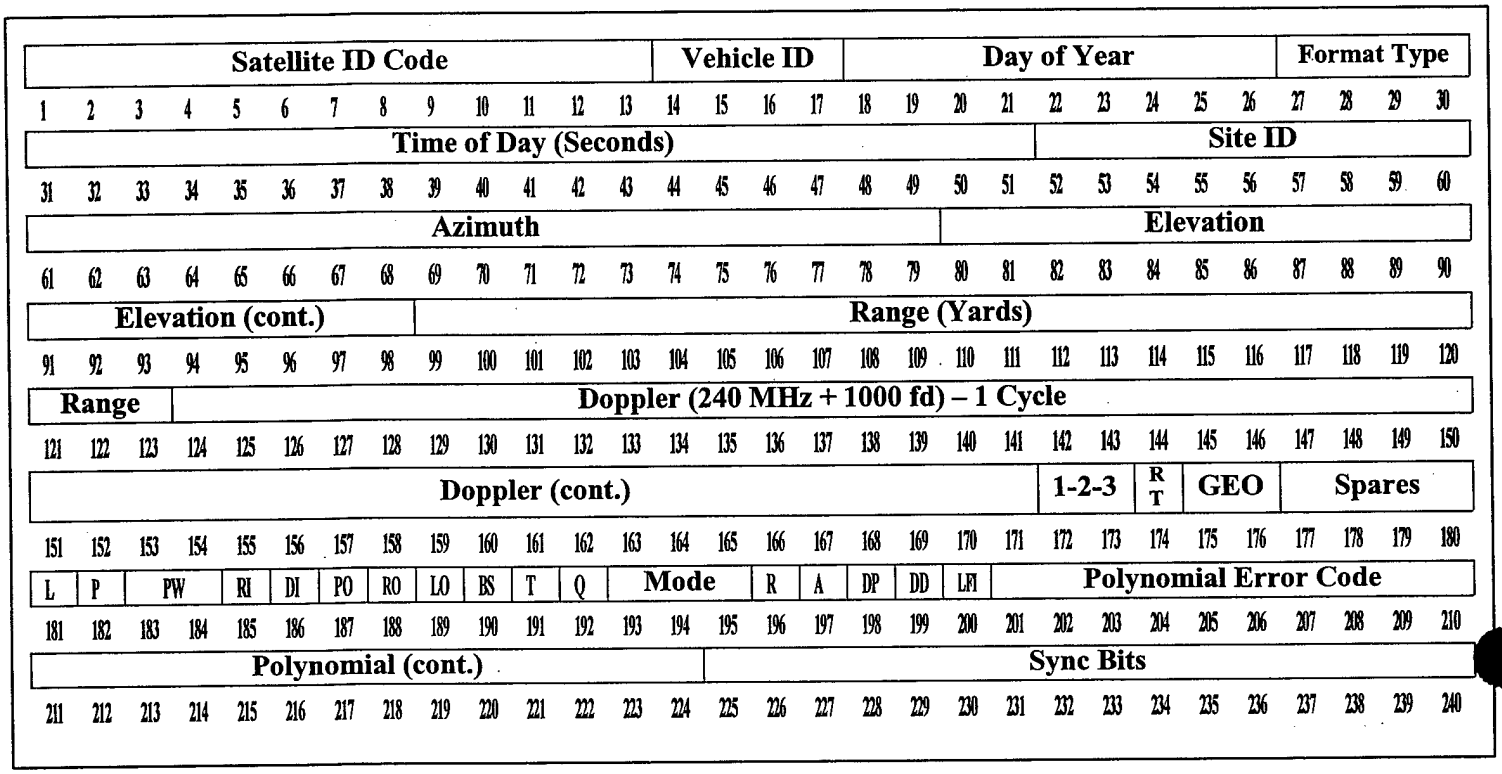


Figure 21. IRIG 240-Bit (MDDF, NASA) Format 8.

Format 9
IRIG 1200-Bit (Space Shuttle) Format (RAE or EFG)

Format 9 is a 1200-bit RTCS/JCS multiplexed tracking data format used between 45 SW (ETR) and NASA. This 1200-bit message is transmitted 6 times per second on a 7.2-kbps line (see figure 22).

Least significant bit weights:

EFG	1 meter (two's complement representation)
EFG	1 meter/second (two's complement rep.)
AZ, EL	1.19842249053566 radians
Range	1.7859375 meters
Position scale codes	(Always zero for RAE data) 00 = do not scale EFG 01 = multiply EFG by 10 10 = multiply EFG by10**3 11 = multiply EFG by 10**10
Velocity scale factor	(Always zero for RAE data) 00 = do not scale EFG 01 = multiply EFG by 10
Format type codes	1000 - Line 1 0110 - Line 2
Source codes	1000 - Best source smoothed vector (EFG) 0100 - Limited best source raw (RAE) 0010 - Limited second best source raw (RAE) 1111 - Null (data slot contents are zero filled)
Data type codes	1000 - Real data 0100 - Test data 0010 - Simulated data 1111 - Null (data slot contents are zero filled)
Status bits**	
Mode	0 = manual, 1 = auto track, 2 = computer drive, 3 = on-axis orbital, 4 = on-axis powered flight, 5 = on-axis coast, 6 = auto-track coast
Quality (Q)	1 = good, 0 = bad
Track **	1 = on, 0 = off
Beacon/Skin	1 = beacon, 0 = skin
Lo **	1 = dual, 0 = single

Radiation (R) **

1 = on 0 = off

PAVAMP (P) **

1 = on 0 = off

DROOP (D) **

1 = in 0 = out

Refraction (REF)

1 = in 0 = out

Pulse Width (PW) **

00 = 1.0 ms 10 = 5.0 ms
01 = 2.4 ms 11 = 10.0 ms

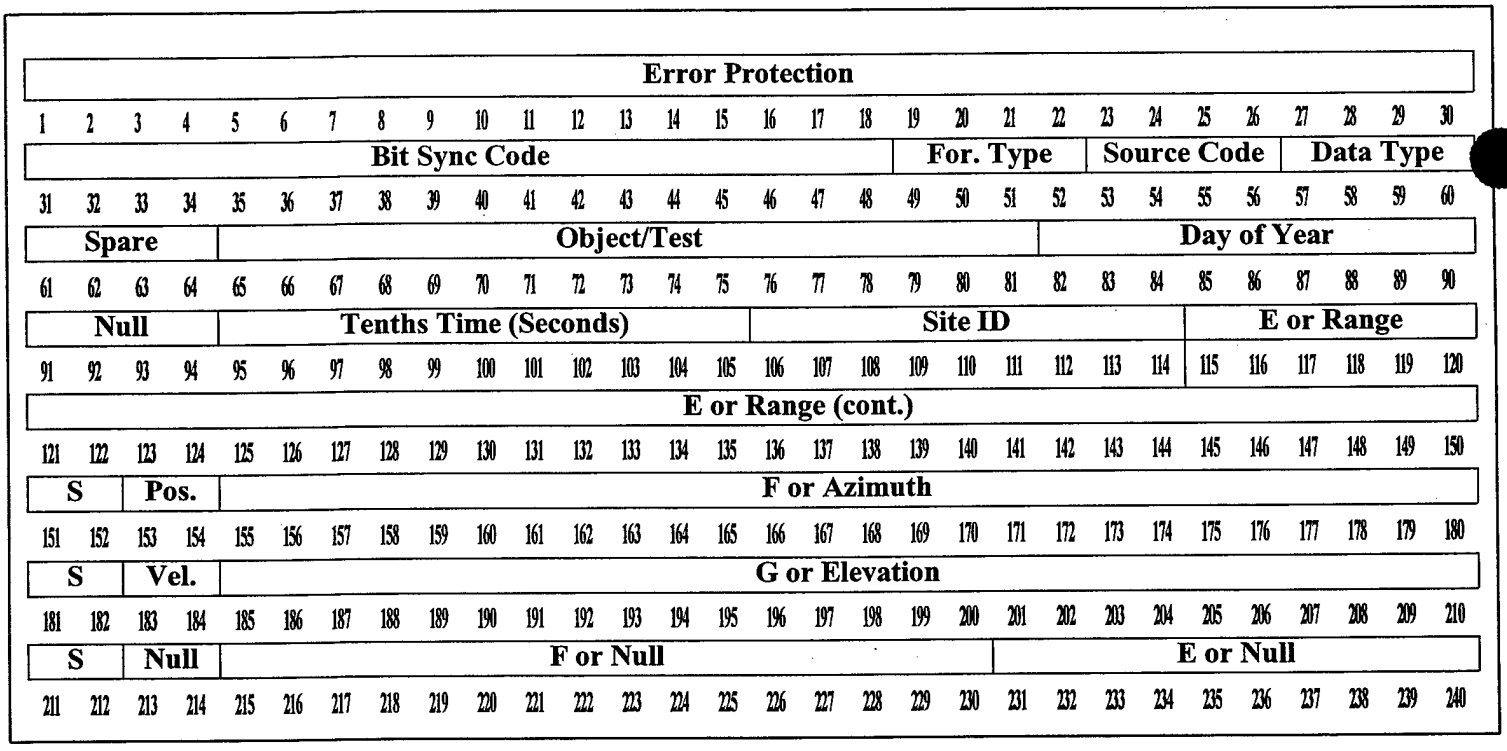
Plunge Mode (PL) **

1 = plunge 0 = normal

Liftoff (LO) **

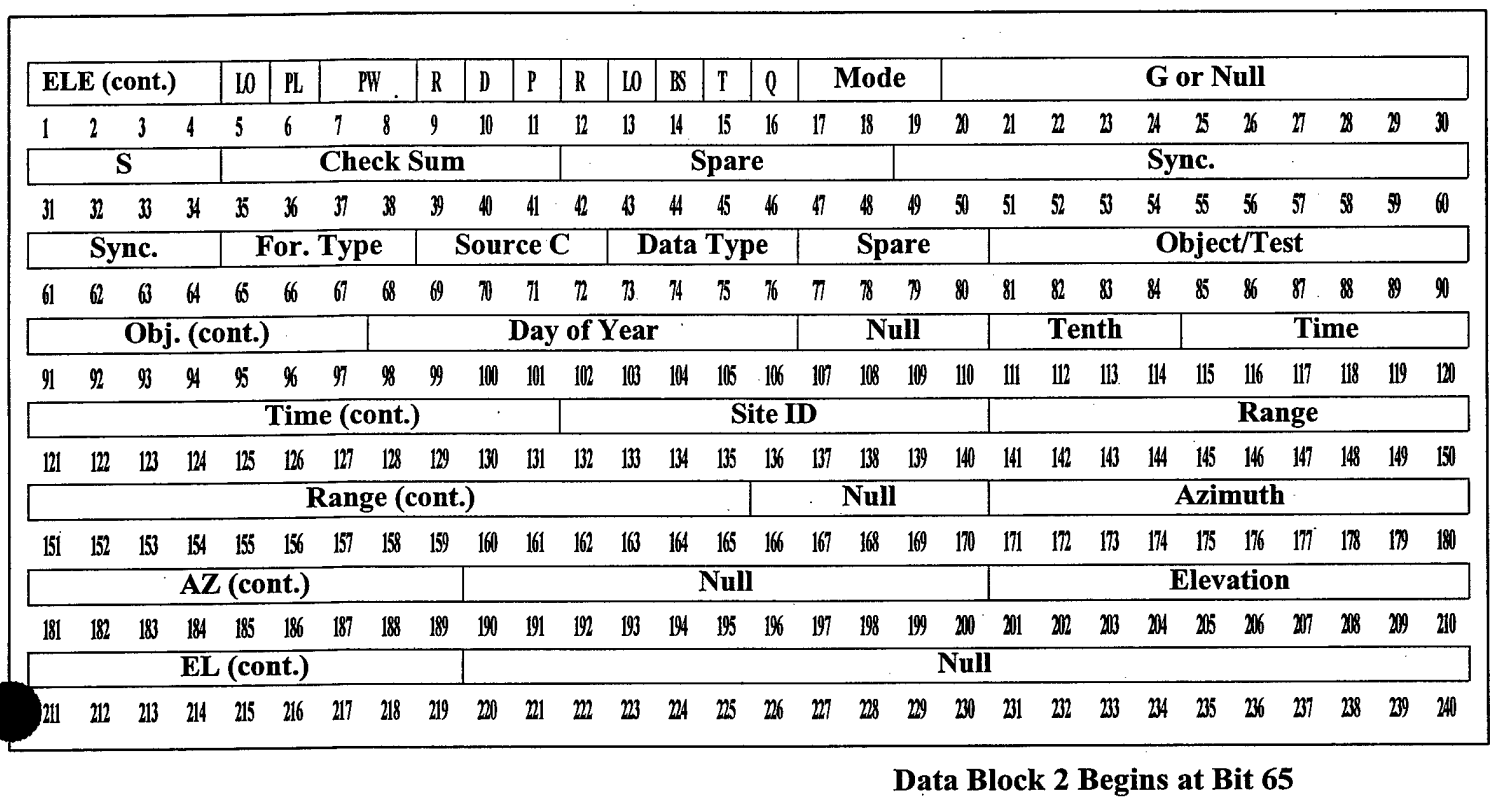
1 = occurred 0 = not occurred

** N/A to JSC data. Set to zero.



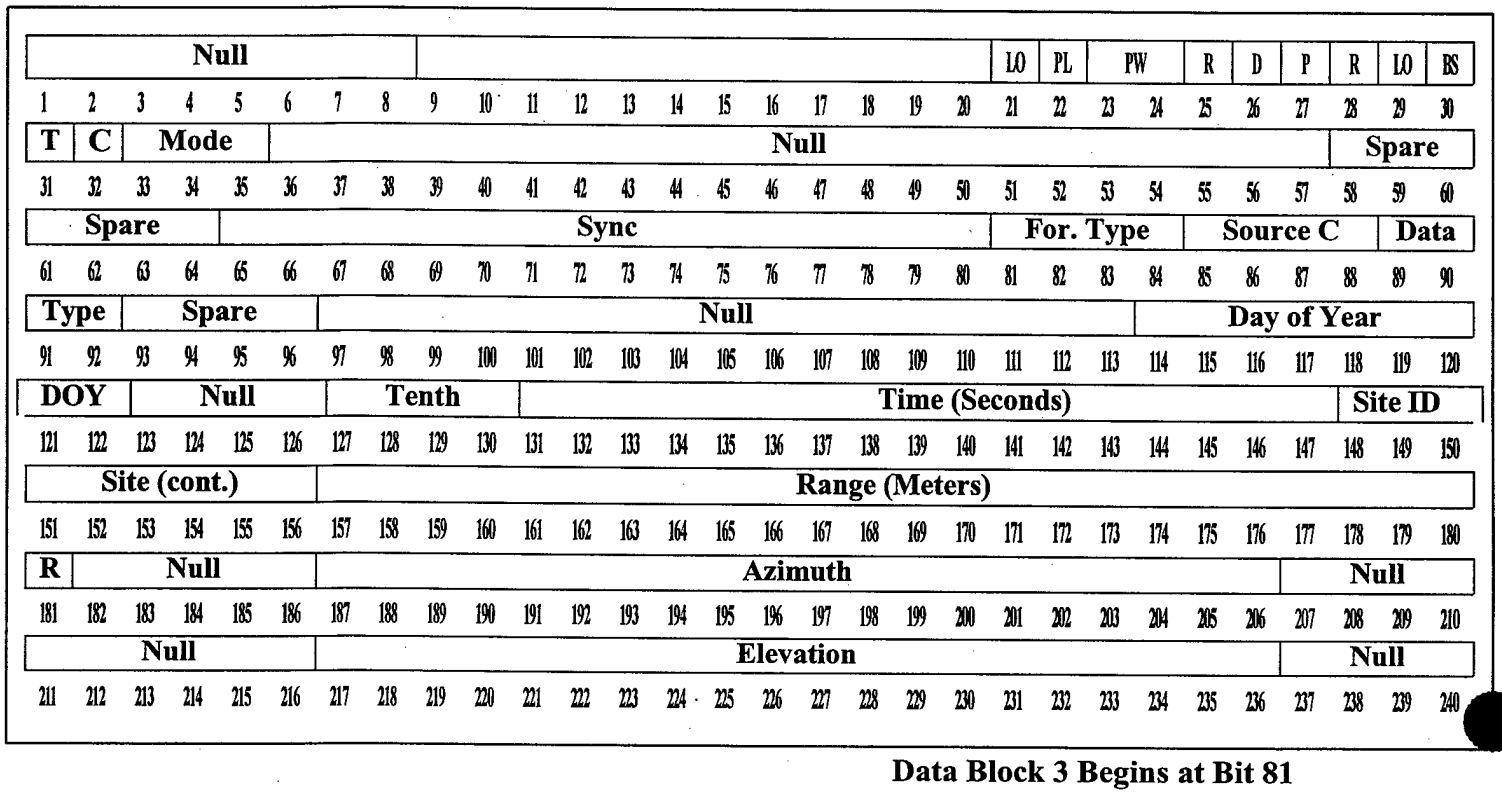
Data Block 1 Begins at Bit 49

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9.



Data Block 2 Begins at Bit 65

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).



Data Block 3 Begins at Bit 81

Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).

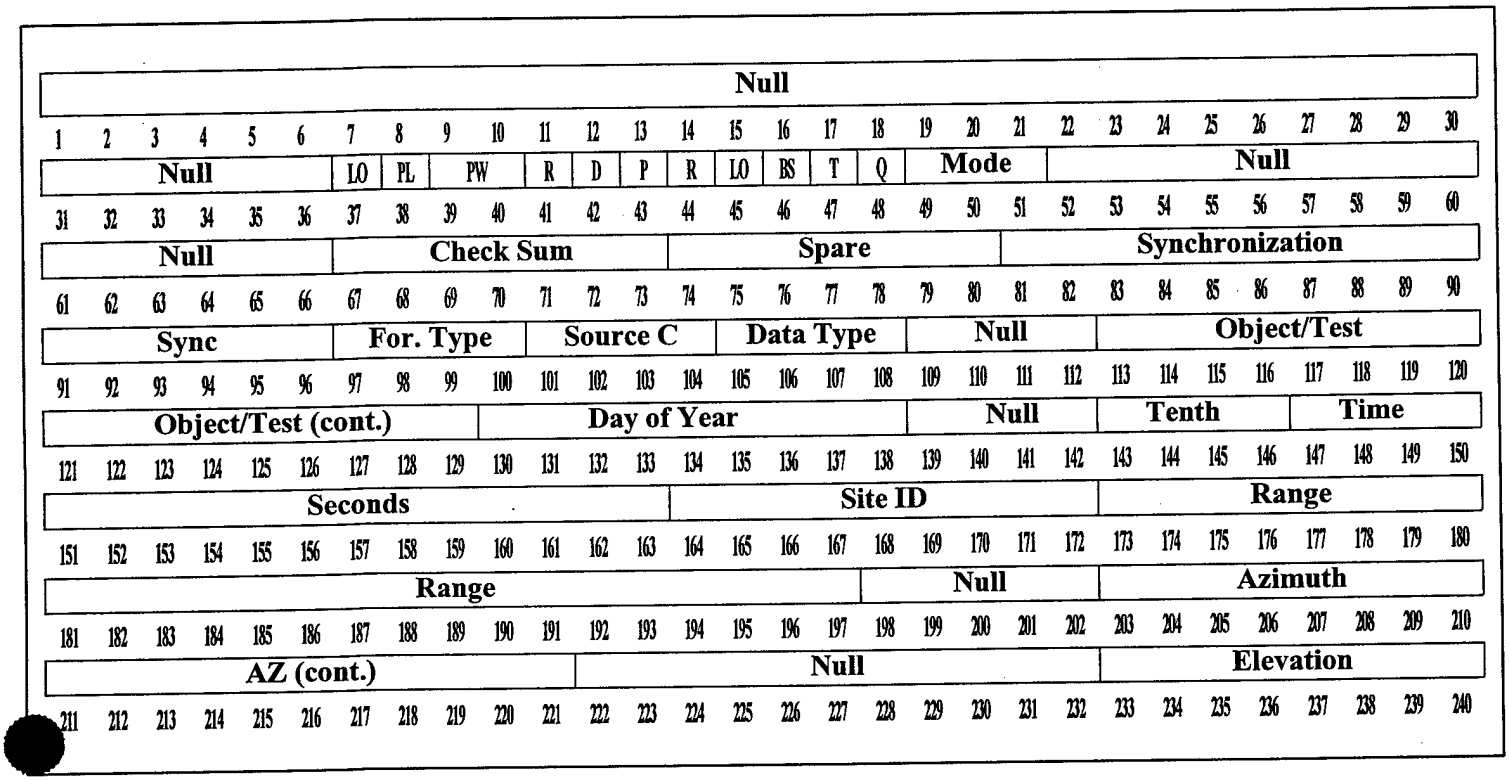


Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).

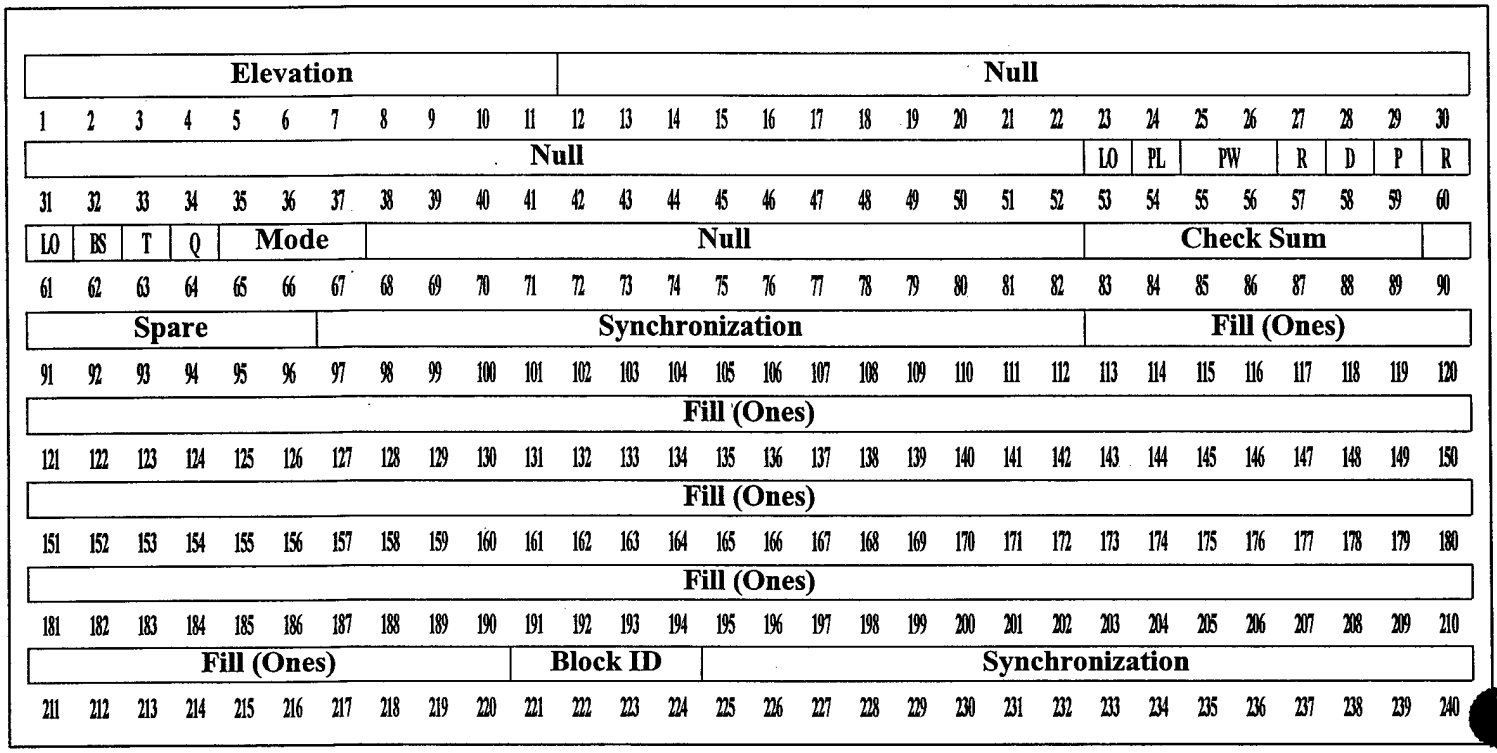


Figure 22. IRIG 1200-Bit (Space Shuttle) Format 9 (cont.).