



EUROCONTROL Specification for Surveillance Data Exchange

ASTERIX Part 21 Category 007
Directed Interrogation Messages
Appendix A: Reserved Expansion Field

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Abstract			
This document specifies the contents of the Reserved Expansion Field for ASTERIX Category 007 messages used for the transmission of Directed Interrogation Messages.			
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DOCUMENT APPROVAL

This document has been approved by the ASTERIX Maintenance Group AMG.

For management approval of the complete set of ASTERIX documentation please refer to Part 1.

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
0.1	February 2010	Creation	All
0.2	March 2010	Definition and Note to TA item updated	2.3
1.0	April 2010	Changed to "Released Issue"	All
1.1	April 2011	Document Id corrected Signature Page updated	Front Page iii
1.2	June 2011	Data item M5N added Data item M4E added	2.4 2.5
1.3	July 2012	Signature Page updated X-Pulse definition updated Subfield #8 (FOM) added to M5N	iii 2.3 2.4 2.4
1.4	November 2012	V, L and G bits added to M5N, SF#5 Mode 1 Code	2.4
1.5	October 2016	Validity flag added to "NAT" in Mode 5 NEW data	2.4
1.6	August 2017	Alignment with Category 048 Reserved Expansion Field Edition 1.9: Data Item "Radar Plot Characteristics" added Extended Range Report item added	2.6 2.7
1.7	April 2022	Alignment with Category 048 Reserved Expansion Field Edition 1.10: Editorial correction in MD5 New Format – Subfield #2-NOV Note added to MD5 New Format – Subfield #5 Range of ERR corrected (includes 256 NM) – please check Note 5 in 2.7.	2.4 2.4 2.7
1.8	July 2024	Alignment with Category 048/REF Edition 1.12 Radar Track Characteristics (RTC) added Common and Plot Characteristics (CPC) added Generic Category 007 (GEN07) added (Check NOTE in I007/REF/GEN07)	2.8 2.9 2.10

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EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 Scope of this Document

This document describes the way to encode information in the Reserved Expansion Field of ASTERIX Cat 007 (Directed Interrogations).

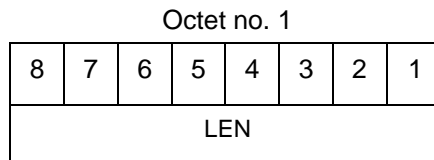
2. DESCRIPTION OF THE CONTENT OF RESERVED EXPANSION FIELD

2.1 Length Indicator

Definition : This field indicates the total length in octets of the Reserved Expansion Field (including the REF length indicator itself)

Format : One-octet fixed length Data Item

Structure:



bits 8-1

(LEN)

Length of REF in octets, including the Length Indicator itself.

Encoding Rule :

This item shall be present in every REF

2.2 Items indicator

Definition : This field indicates what are the items encoded in the REF

Format : One-octet fixed length Data Item

Structure:

Octet no. 1

8	7	6	5	4	3	2	1
TA	M5N	M4E	RPC	ERR	RTC	CPC	GEN07

bit 8	(TA)	= 0 Target Altitude is not present in the REF = 1 Target Altitude is present in the REF
bit 7	(M5N)	= 0 Mode 5 New is not present in the REF = 1 Mode 5 New is present in the REF
bit 6	(M4E)	= 0 Extended Encoding for Mode 4 is not present in the REF = 1 Extended Encoding for Mode 4 is present in the REF
bit 5	(RPC)	= 0 Radar Plot Characteristics is not present in the REF = 1 Radar Plot Characteristics is present in the REF
bit 4	(ERR)	= 0 Extended Range Report is not present in the REF = 1 Extended Range Report is present in the REF
bit 3	(RTC)	= 0 Radar Track Characteristics is not present in the REF = 1 Radar Track Characteristics is present in the REF
bit 2	(CPC)	= 0 Common and Plot Characteristics is not present in the REF = 1 Common and Plot Characteristics is present in the REF

bit 1	(GEN07)	= 0 Generic Category 007 Data Item is not present in the REF
		= 1 Generic Category 007 Data Item is not present in the REF

Encoding Rule :

This item shall be present in every REF

2.3 TA Target Altitude

Definition: Potential height of a target to be interrogated. The height shall use mean sea level as the zero reference level.

Format: Four-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
0	0	TA _{max}											LSB		

Octet no. 3								Octet no. 4							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	0	TA _{min}											LSB		

bits-32/31	(spare)	Spare bits, set to 0
bits-30/17	(TA _{max})	Maximum value of potential target altitude =25ft
bit 17	(LSB)	
bits-16/15	(spare)	Spare bits, set to 0
bits-14/1	(TA _{min})	Minimum value of potential target altitude =25ft
bit 1	(LSB)	

NOTE: Negative Values are expressed in two's complement
 $TA_{min} \leq TA_{max}$

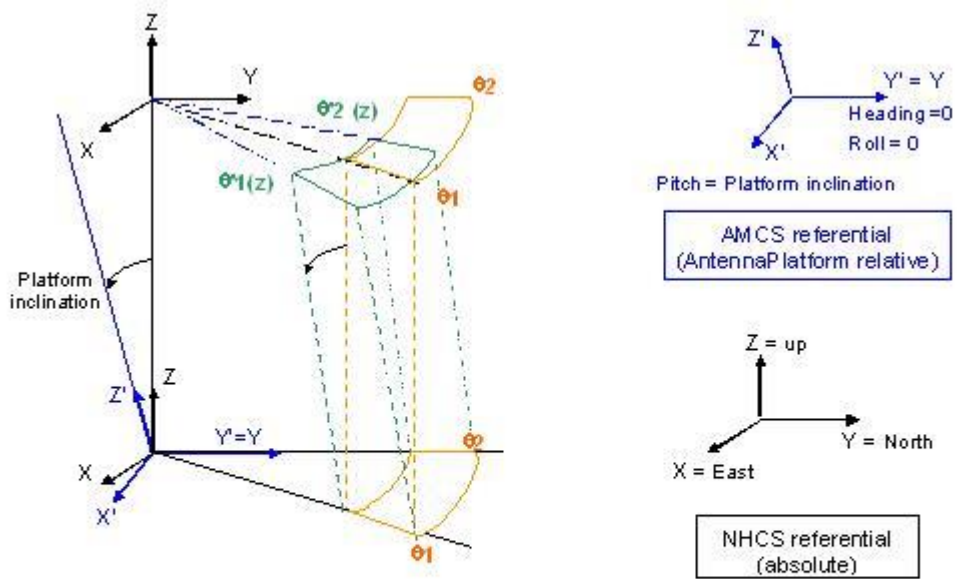
Encoding Rule :
 This Item is optional.

Application :

When operating a sensor on a moving platform (such as a ship) it is subjected to movements around the three special axes (heading, roll, pitch).

As shown in the diagram hereafter, the start and end value for the interrogation window differs depending on the movement of the sensor. In order to compensate for these variations, it is required to indicate to the sensor the altitude of the target in order to calculate the potential differences in the start and end angle of the interrogation window.

This REF implements the capability to indicate to the sensor the potential height band in which the target to be interrogated can be expected.



2.4 M5N - Mode 5 New

Definition: Mode 5 Data/Reports, Extended Mode 1 Code and X pulse following the updated NATO format for the National Origin code

Format: Compound data item comprising of a primary subfield of up to two octets, followed by the indicated subfields.

Note: In 2011 NATO has modified the format of the National Origin information available in subfield 2 of the Mode 5 data item (I007/085). The information for National Origin and Mission Code were combined into a 11-bit long field. In order to maintain backwards compatibility and to ease the use of the new layout, the original Mode 5 data item (I007/085) was copied into this Reserved Expansion Field and the layout of subfield #2 adapted.

The new layout is reflected in this data item M5N and shall be used by equipment prepared for the new National Origin system.

Equipment certified to the previous encoding shall continue to use the data item MD5 corresponding to the 5-bit National Origin / 6-bit Mission Code as described in data item I007/085 of the main ASTERIX category 007 specification.

Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
16	15	14	13	12	11	10	9
SUM	PMN	POS	GA	EM1	TOS	XP	FX

Octet no. 2							
8	7	6	5	4	3	2	1
FOM	0	0	0	0	0	0	FX

- bit-16, octet 1 (SUM) Subfield #1: Mode 5 Summary
 =0 Absence of Subfield #1
 =1 Presence of Subfield #1

- bit-15, octet 1 (PMN) Subfield #2: Mode 5 PIN/ National Origin
 =0 Absence of Subfield #2
 =1 Presence of Subfield #2

- bit-14, octet 1 (POS) Subfield #3: Mode 5 Reported Position
 =0 Absence of Subfield #3
 =1 Presence of Subfield #3

- bit-13, octet 1 (GA) Subfield #4: Mode 5 GNSS-derived Altitude
 =0 Absence of Subfield #4
 =1 Presence of Subfield #4

- bit-12, octet 1 (EM1) Subfield #5: Extended Mode 1 Code in Octal Representation
 =0 Absence of Subfield #5
 =1 Presence of Subfield #5

- bit-11, octet 1 (TOS) Subfield #6: Time Offset for POS and GA.
 =0 Absence of Subfield #6
 =1 Presence of Subfield #6

- bit-10, octet 1 (XP) Subfield #7: X Pulse Presence
 =0 Absence of Subfield #7
 =1 Presence of Subfield #7

- bit-9, octet 1 (FX) = 0 End of Primary Subfield
 = 1 Extension of Primary Subfield into next octet

bit-8, octet 2 (FOM) Subfield #8: Figure of Merit
=0 Absence of Subfield #8
=1 Presence of Subfield #8

bits-7/2, octet 2 (spare) Spare bits, set to 0

bit-1, octet 2 (FX) = 0 End of Primary Subfield
= 1 Extension of Primary
Subfield into next octet

**Structure of Subfield #1:
Mode 5 Summary:**

Octet no. 1

8	7	6	5	4	3	2	1
M5	ID	DA	M1	M2	M3	MC	0

- | | | |
|-------|------|---|
| bit-8 | (M5) | = 0 No Mode 5 interrogation
= 1 Mode 5 interrogation |
|-------|------|---|
- | | | |
|-------|------|--|
| bit-7 | (ID) | = 0 No authenticated Mode 5 ID
reply/report
= 1 Authenticated Mode 5 ID reply/report |
|-------|------|--|
- | | | |
|-------|------|--|
| bit-6 | (DA) | = 0 No authenticated Mode 5 Data reply
or Report
= 1 Authenticated Mode 5 Data reply or
Report (i.e any valid Mode 5 reply
type other than ID) |
|-------|------|--|
- | | | |
|-------|------|--|
| bit-5 | (M1) | = 0 Mode 1 code not present or not from
Mode 5 reply/report
= 1 Mode 1 code from Mode 5
reply/report. |
|-------|------|--|
- | | | |
|-------|------|--|
| bit-4 | (M2) | = 0 Mode 2 code not present or not from
Mode 5 reply/report
= 1 Mode 2 code from Mode 5
reply/report. |
|-------|------|--|
- | | | |
|-------|------|--|
| bit-3 | (M3) | = 0 Mode 3 code not present or not from
Mode 5 reply/report
= 1 Mode 3 code from Mode 5
reply/report. |
|-------|------|--|
- | | | |
|-------|------|---|
| bit-2 | (MC) | = 0 Mode C altitude not present or not
from Mode 5 reply/report
= 1 Mode C altitude from Mode 5
reply/report |
|-------|------|---|
- | | | |
|-------|--------------------|--|
| bit-1 | Spare bit set to 0 | |
|-------|--------------------|--|

Notes:

1. The flags M2, M3, MC refer to the contents of data items I007/050, I007/070 and I007/090 respectively. The flag M1 refers to the contents of data item I007/055, Mode 1 Code in Octal Representation, and to the contents of the Subfield #5 (Extended Mode 1 Code in Octal Representation).
2. If an authenticated Mode 5 reply/report is received with the Emergency bit set, then the Military Emergency bit (ME) in Data Item I007/020, Target Report Descriptor, shall be set.
3. If an authenticated Mode 5 reply/report is received with the Identification of Position bit set, then the Special Position Identification bit (SPI) in Data Item I007/020, Target Report Descriptor, shall be set.

**Structure of Subfield #2:
Mode 5 PIN /National Origin**

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
0	0	PIN												(LSB)	

Octet no. 3					Octet no. 4										
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	0	0	0	NOV	NO										

- bits-32/31 (spare) spare bits set to 0
- bits-30/17 (PIN) PIN Code
- bits-16/13 (spare) spare bits set to 0
- bit-12 (NOV) Validity of NO
=0: National Origin is valid
=1: National Origin is invalid
- bits-11/1 (NO) National Origin Code

Note: Bit 12 (NOV) is set to 1 if the value for National Origin is not known or invalid. Under certain conditions PIN is available but NO is not available. NOV then indicates that the NO field was not actively populated.

**Structure of Subfield #3:
Mode 5 Reported Position**

Octet no. 1								Octet no. 2							
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
Latitude in WGS 84															

Octet no. 3								Octet no. 4							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
(LSB)								Longitude in WGS 84							

Octet no. 5								Octet no. 6							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
(LSB)															

bits-48/25 (LAT) Latitude in WGS 84

bits-24/1 (LON) Longitude in WGS 84

Notes : Latitude in WGS 84 is expressed as a 24-bit two's complement number.
 Range $-90^{\circ} \leq \text{latitude} \leq 90^{\circ}$. Sign convention: North is positive.
 LSB = $180/2^{23}$ degrees = $2.145767 \cdot 10^{-05}$ degrees

Longitude in WGS 84 is expressed as a 24-bit two's complement number.
 Range $-180^{\circ} \leq \text{longitude} < 180^{\circ}$. Sign convention: East is positive.
 LSB = $180/2^{23}$ degrees = $2.145767 \cdot 10^{-05}$ degrees

The resolution implied by the LSB is better than the resolution with which Mode 5 position reports are transmitted from aircraft transponders using currently defined formats.

**Structure of Subfield #4:
Mode 5 GNSS-derived Altitude**

Octet no. 1							Octet no. 2								
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	RES	GA										(LSB)			

- bit-16 (spare) spare bit set to 0
- bit-15 (RES) Resolution with which the GNSS-derived Altitude (GA) is reported.
=0 GA reported in 100 ft increments,
=1 GA reported in 25 ft increments.
- bits-14/1 (GA) GNSS-derived Altitude of target, expressed as height above WGS 84 ellipsoid. GA is coded as a 14-bit two's complement binary number with an LSB of 25 ft. irrespective of the setting of RES. The minimum value of GA that can be reported is -1000 ft.

**Structure of Subfield #5:
Extended Mode 1 Code in Octal Representation**

Octet 1				Octet 2											
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	L	0	Extended Mode 1 Code											
				A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1

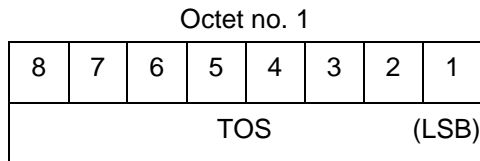
- bit-16 (V) = 0 Code not validated (see note 2)
= 1 Code validated (see note 2)
- bit-15 (G) = 0 Default
= 1 Garbled code
- bit-14 (L) = 0 Mode-3/A code derived from the reply of the transponder
= 1 Mode-3/A code not extracted during the last scan
- bit-13 (spare) spare bit, set to "0"
- bits-12/1 (EM1) Extended Mode 1 Code in octal representation

Note 1: If Subfield #1 is present, the M1 bit in Subfield #1 indicates whether the Extended Mode 1 Code is from a Mode 5 reply or a Mode 1 reply. If Subfield #1 is not present, the Extended Mode 1 Code is from a Mode 1 reply.

Note 2: For reasons of backwards compatibility the logic for the setting of the V-bit was inverted compared to other similar data items.

Note 3: The values of the bits for V, G, L, A4, A2, A1, B2 and B1 **shall** be identical to the values of the corresponding bits in data item I007/055.

**Structure of Subfield #6 of Compound Data Item:
Time Offset for POS and GA**



bits-8/1 (TOS)

Time Offset coded as a twos complement number with an LSB of 1/128 s. The time at which the Mode 5 Reported Position (Subfield #3) and Mode 5 GNSS-derived Altitude (Subfield #4) are valid is given by Time of Day (I007/140) plus Time Offset.

Note:

TOS **shall** be assumed to be zero if Subfield #6 is not present.

**Structure of Subfield #7 of Compound Data Item:
X Pulse Presence**

Octet no. 1

8	7	6	5	4	3	2	1
0	0	XP	X5	XC	X3	X2	X1

bits-8/7 spare bits set to zero

- bit-6 (XP) X-pulse from Mode 5 PIN reply/report
 = 0 X-Pulse not present.
 = 1 X-pulse present.
- bit-5 (X5) X-pulse from Mode 5 Data reply or Report.
 = 0 X-pulse set to zero or no authenticated Data reply or Report received.
 = 1 X-pulse set to one (present).
- bit-4 (XC) X-pulse from Mode C reply
 = 0 X-pulse set to zero or no Mode C reply
 = 1 X-pulse set to one (present)
- bit-3 (X3) X-pulse from Mode 3/A reply
 = 0 X-pulse set to zero or no Mode 3/A reply
 = 1 X-pulse set to one (present)
- bit-2 (X2) X-pulse from Mode 2 reply
 = 0 X-pulse set to zero or no Mode 2 reply
 = 1 X-pulse set to one (present)
- bit-1 (X1) X-pulse from Mode 1 reply
 = 0 X-pulse set to zero or no Mode 1 reply
 = 1 X-pulse set to one (present)

NOTE to Subfield #7 (X Pulse Presence):

Within Mode 5 replies/reports, the X-Pulse can be set for the following cases:

1. In a combined Mode 1 and Mode 2 reply/report: in this case the X5 bit and the X2 bit shall be set;
2. In a combined Mode 3 and Mode C reply/report: in this case the X5 bit and the X3 bit shall be set;
3. In a Mode 5 PIN data reply/report: in this case the X5 bit and the XP bit shall be set.

The X1 bit and the XC bit are meaningless as in Mode 1 and Mode C replies/reports the X Pulse is not defined. They are kept for compatibility reasons.

**Structure of Subfield #8 of Compound Data Item:
Figure of Merit**

Octet no. 1							
8	7	6	5	4	3	2	1
0	0	0	FOM				

bits-8/6 (spare) spare bits set to zero

bits-5/1 (FOM) Figure of Merit
Position Accuracy as extracted and
provided by a Mode 5 transponder

2.5 M4E – Extended Mode 4

Definition: Extended encoding of the Mode 4 interrogation result

Format: Variable length Data Item comprising a first part of one-octet, followed by one-octet extents as necessary.

Structure:

Octet no. 1							
8	7	6	5	4	3	2	1
0	0	0	0	0	FOE/FRI		FX

Bits 8/4 (spare) spare bits, set to 0

Bits 3/2 (FOE/FRI) Indication Foe/Friend (Mode4)
 = 00 No Mode 4 identification
 = 01 possibly friendly target
 = 10 probably friendly target
 = 11 friendly target

Bit-1 (FX) = 0 End of Data Item
 = 1 Extension into first extent

Encoding Rule :

This item is optional and shall be used if the IFF interrogator is capable to encode the extended Mode 4 interpretation.

2.6 Radar Plot Characteristics

Definition: Extension to data item I007/130 for primary reports

Format: Compound Data Item comprising a first part of one-octet extensible, followed by the indicated subfields.

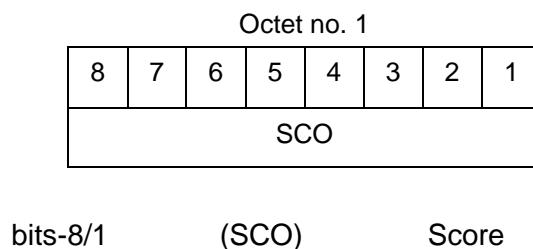
Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
SCO	SCR	RW	AR	0	0	0	FX

bit-8	(SCO)	Subfield #1: Score =0 Absence of Subfield #1 =1 Presence of Subfield #1
bit-7	(SCR)	Subfield #2: Signal/Clutter Ratio =0 Absence of Subfield #2 =1 Presence of Subfield #2
bit-6	(RW)	Subfield #3: Range Width =0 Absence of Subfield #3 =1 Presence of Subfield #3
bit-5	(AR)	Subfield #4: Ambiguous Range =0 Absence of Subfield #4 =1 Presence of Subfield #4
Bits-4/2	(spare)	Spare bits, set to 0
bit-1	(FX)	= 0 End of Primary Subfield = 1 Extension of Primary

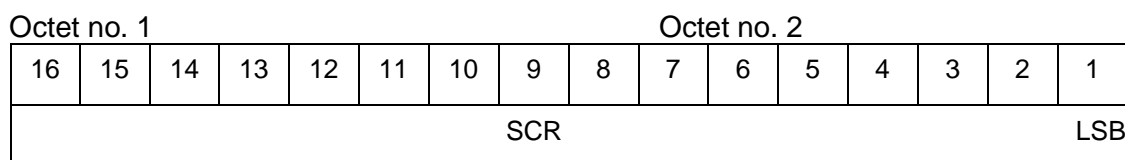
Structure of Subfield #1 of Compound Data Item: Score

The score describes the number of raw responses used to create the plot.



Structure of Subfield #2: Signal / Clutter Ratio

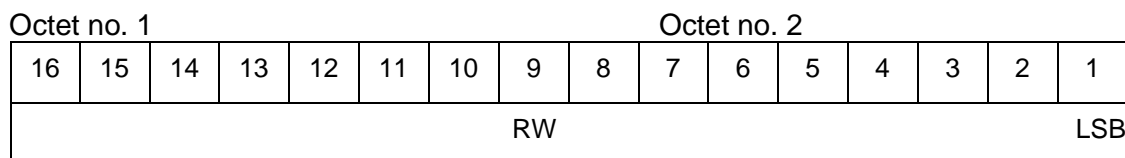
The Signal / Clutter Ratio describes the difference in signal strength between the signal constituting the raw plot and the signal of the clutter.



bits-16/1 (SCR) Signal to Clutter Ratio
 LSB = 0.1 db
 0.1 db < SCR < 2550

Structure of Subfield #3: Range Width

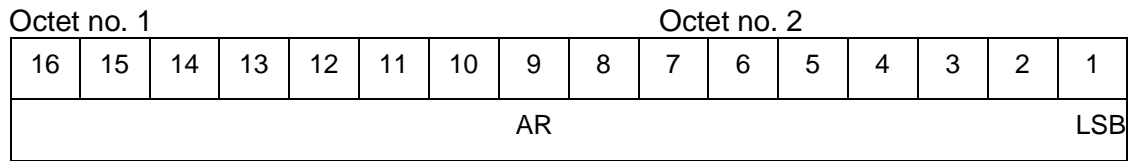
The Range Width defines the difference in range between the closest proximity to the radar of the raw response and the point farthest away from the radar.



bits-16/1 (RW) Range Width
 LSB = 1/256 NM
 Max. value: 256 NM

Structure of Subfield #4: Ambiguous Range

The Ambiguous Range describes the Pulse Repetition Interval of the radar in range.



bits-16/1 (AR)

Ambiguous Range
 LSB = 1/256 NM
 Max. value: 256 NM

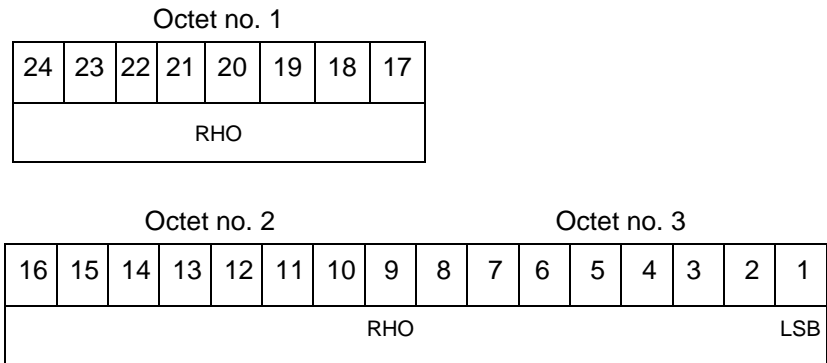
Encoding Rule :
 This item is optional.

2.7 Extended Range Radar

Definition: Adaptation of data item I007/040 to extended range radars for provision of the measured position of an aircraft in local polar coordinates with a range equal to or greater than 256NM

Format: Three-octet fixed length data item.

Structure:



$$\text{bit-1 (LSB)} = \frac{1}{256} \text{ NM.}$$

Max. range = 65535 NM

Encoding Rule :

This item is optional. It **shall** only be sent if the value of RHO is equal to or greater than 256NM.

NOTES

1. For radars with an operational range beyond 256 NM data item I007/040 is insufficient. These radars may use this extension to provide the target position equal to or beyond 256 NM. In such cases, data item I007/040 **shall** be transmitted **in addition to this extension**. In this case it is recommended to set bits 32/17 in data item I007/040 to "1".
2. The Encoding Rule for data item I007/040 still applies.
3. This item represents the measured target position of the plot, even if associated with a track, for the present antenna scan. It is expressed in polar co-ordinates in the local reference system, centred on the radar station.
4. In case of combined detection by a PSR and an SSR, then the SSR position is sent.
5. Before migrating an ASTERIX encoder to Edition 1.7 of this specification, care has to be taken that receiving decoders allow the presence of the value 256 NM in the record. Systems applying a range check may otherwise suppress the record.

2.8 Radar Track Characteristics

Definition: Additional Track Characteristics

Format: Compound Data Item comprising a primary subitem of one-octet extensible, followed by the indicated subitems.

Structure of Primary Subitem:

Octet no. 1							
16	15	14	13	12	11	10	9
PTL	ATL	TRN	NPP	DLK	LCK	TC	FX

bit-16	(PTL)	Subfield #1: Plot/Track Link =0 Absence of Subfield #1 =1 Presence of Subfield #1
bit-15	(ATL)	Subfield #2: ADS-B/Track Link =0 Absence of Subfield #2 =1 Presence of Subfield #2
bit-14	(TRN)	Subfield #3: Turn State =0 Absence of Subfield #3 =1 Presence of Subfield #3
bit-13	(NPP)	Subfield #4: Next Predicted Position =0 Absence of Subfield #4 =1 Presence of Subfield #4
bit-12	(DLK)	Subfield #5: Data Link Characteristics =0 Absence of Subfield #5 =1 Presence of Subfield #5
bit-11	(LCK)	Subfield #6: Lockout Characteristics =0 Absence of Subfield #6 =1 Presence of Subfield #6
bit-10	(TC)	Subfield #7: Transition Code =0 Absence of Subfield #7 =1 Presence of Subfield #7
bit-9	(FX)	=0 End of Primary Subfield =1 Extension of Primary

Structure of First Extension of Primary Subitem:

Octet no. 1							
8	7	6	5	4	3	2	1
TLC	ASI	TES	IR	0	0	0	FX

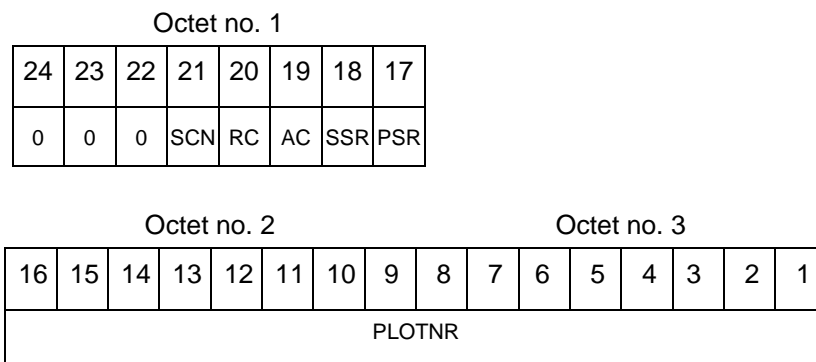
- bit-8 (TLC) Subfield #8: Track Life Cycle
 =0 Absence of Subfield #8
 =1 Presence of Subfield #8
- bit-7 (ASI) Subfield #9: Adjacent Sensor Information
 =0 Absence of Subfield #9
 =1 Presence of Subfield #9
- bit-6 (TES) Subfield #10: Track Extrapolation Source
 =0 Absence of Subfield #10
 =1 Presence of Subfield #10
- bit-5 (IR) Subfield #11: Identity Requested
 =0 Absence of Subfield #11
 =1 Presence of Subfield #11
- bits-4/2 (spare) Spare bits, set to 0
- bit-1 (FX) =0 End of Primary Subfield
 =1 Extension of Primary

Structure of Subfield #1 of “Radar Track Characteristics”: Plot/Track Link

Definition: Providing link between a track and its associated plot.

Format: Fixed-length item starting with one octet for the plot components and two octets for the plot number.

Structure:



bits-24/22	(SPARE)	Spare Bits, set to 0
bits-21	(SCN)	Track / SCN association =0 Track is not associated with an SCN Plot =1 Track is associated with an SCN Plot
bit-20	(RC)	Roll Call Component =0 Associated Plot does not contain a Roll Call component =1 Associated Plot contains at least a Roll Call component
bit-19	(AC)	All Call Component =0 Associated Plot does not contain an All Call component =1 Associated Plot contains at least an All Call component
bit-18	(SSR)	SSR Component =0 Associated Plot does not contain an SSR component =1 Associated Plot contains at least an SSR component
bit-17	(PSR)	PSR Component =0 Associated Plot does not contain a PSR component =1 Associated Plot contains at least a PSR component

bits-16/1	(PLOTNR)	Unique reference to the associated plot record (see Note)
-----------	----------	---

NOTE: (to bits-16/1): If SCN = 0, PLOTNR **shall** be set to 0.

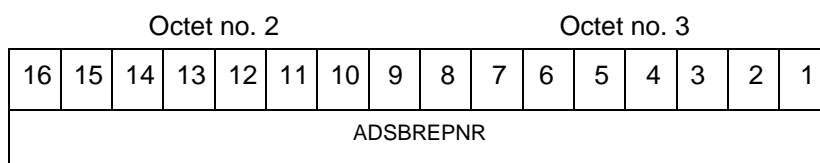
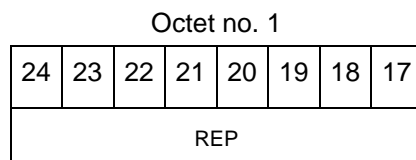
NOTE: (to bit-21): If SCN = 1, I007/020/SCN#VAL – if implemented - **shall** be set to “1”.

Structure of Subfield #2 of “Radar Track Characteristics”: ADS-B/Track Link

Definition: Providing link between a track and its associated ADS-B Report.

Format: Repetitive Data Item starting with a one-octet Field Repetition Indicator followed by at least one ADS-B Report Reference Number composed of two octets.

Structure:



bits-24/17 (REP) Repetition Factor

bits-16/1 (ADSBREPNR) Reference to an ADS-B Report

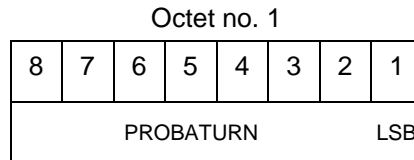
NOTE: The presence of this information **shall** be communicated in Data Item I007/020 by setting I007/020/ADSB#VAL – if implemented - = 1.

Structure of Subfield #3 of “Radar Track Characteristics”: Turn State

Definition: Turn State with probability with regards to track evolution hypothesis (Circular model).

Format: One octet fixed length data item.

Structure:



bits-8/1 (PROBATURN) Probability of a Circular Model

bit-1 (LSB) LSB = 1%

NOTE: The probability of a straight line with a Linear Model is 100%-PROBATURN.

Structure of Subfield #4 of “Radar Track Characteristics”: Next Predicted Position

Definition: Next predicted position for a track update at the next expected antenna rotation in reference to the current track update.

Format: Twentytwo (22) octets fixed length data item.

Structure:

Octet no. 1											Octet no. 2				
176	175	174	173	172	171	170	169	168	167	166	165	164	163	162	161
PREDRHO															LSB

Octet no. 3											Octet no. 4				
160	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145
PREDTHETA															LSB

Octet no. 5											Octet no. 6				
144	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129
EVOLRHOSTART															LSB

Octet no. 7											Octet no. 8				
128	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113
EVOLRHOEND															LSB

Octet no. 9											Octet no. 10				
112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97
EVOLTHETASTART															LSB

Octet no. 11											Octet no. 12				
96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81
EVOLTHETAEND															LSB

Octet no. 13											Octet no. 14				
80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65
NOISERHOSTART															LSB

Octet no. 15								Octet no. 16							
64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
NOISERHOEND														LSB	
Octet no. 17								Octet no. 18							
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
NOISETHETASTART														LSB	
Octet no. 19								Octet no. 20							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
NOISETHETAEND														LSB	
Octet no. 21								Octet no. 22							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
PREDTIME														LSB	

Predicted position in polar coordinates of the target at next detection:

bits-176/161 (PREDRHO) Predicted Range
 bit-161 (LSB) LSB = 1/128NM

bits-160/145 (PREDTHETA) Predicted Azimuth
 bit-145 (LSB) LSB = 360° / 2¹⁶

Predicted window size of the target position at next detection based on the tracking algorithm (Evolution Window):

bits-144/129 (EVLRHOSTART) Predicted Closest Range
 bit-129 (LSB) LSB = 1/128NM

bits-128/113 (EVLRHOEND) Predicted Largest Range
 bit-113 (LSB) LSB = 1/128NM

bits-112/97 (EVLTHETASTART) Predicted Smallest Azimuth
 bit-97 (LSB) LSB = 360° / 2¹⁶ (see Note)

bits-96/81 (EVLTHETAEND) Predicted Largest Azimuth
 bit-81 (LSB) LSB = 360° / 2¹⁶ (see Note)

Predicted window size of the target position at next detection based on the technical radar characteristics (Noise Window):

bits-80/65 bit-65	(NOISERHOSTART) (LSB)	Predicted Closest Range LSB = 1/128NM
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bits-64/49 bit-49	(NOISERHOEND) (LSB)	Predicted Largest Range LSB = 1/128NM
----------------------	------------------------	--

bits-48/33 bit-33	(NOISETHETASTART) (LSB)	Predicted Smallest Azimuth LSB = $360^0 / 2^{16}$ (see Note)
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bits-32/17 bit-17	(NOISETHETAEND) (LSB)	Predicted Largest Azimuth LSB = $360^0 / 2^{16}$ (see Note)
----------------------	--------------------------	--

Predicted time of next detection relative to the Time of Day of the current track update: (see Note)

bits-16/1 bit-1	(PREDTIME) (LSB)	Predicted Detection Time LSB = 1/128 seconds
--------------------	---------------------	---

NOTE: When the area crosses North, THETASTART is larger than THETAEND.

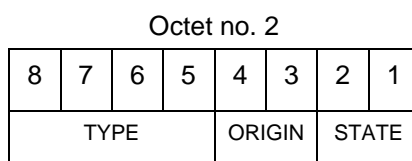
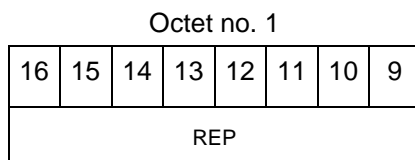
NOTE: Next detection = Time of Day of current track record + PREDTIME.

Structure of Subfield #5 of “Radar Track Characteristics”: Data Link Characteristics

Definition: Active message list for the aircraft for the current scan.

Format: Repetitive Data Item consisting of a one-octet repetition factor followed by at least one octet of the relevant information.

Structure:



- | | | |
|-----------|-------|-------------------|
| bits-16/9 | (REP) | Repetition Factor |
|-----------|-------|-------------------|
- | | | |
|----------|--------|--|
| bits-8/5 | (TYPE) | Type of Message Protocol
= 0 Surveillance Mode A (alert bit or periodic)
= 1 Comm-A
= 2 Ground Initiated Comm-B
= 3 Air Initiated Comm-B
= 4 Broadcast Comm-B
= 5 Comm-C
= 6 Comm-D
= 7 – 15 Reserved for future use |
|----------|--------|--|
- | | | |
|----------|----------|---|
| bits-4/3 | (ORIGIN) | Frame Detection
= 0 From previous scan
= 1 New in current scan
= 2 Requested in the beam by transponder
= 3 Invalid ASTERIX value |
|----------|----------|---|
- | | | |
|----------|---------|---|
| bits-2/1 | (STATE) | Frame state at aircraft release
= 0 In progress
= 1 Completed
= 2 Cancelled
= 3 Invalid ASTERIX value |
|----------|---------|---|

Structure of Subfield #6 of “Radar Track Characteristics”: Lockout Characteristics

Definition: Lockout State and remaining Lockout Time

Format: Two-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
LS	LOCTIM													LSB	

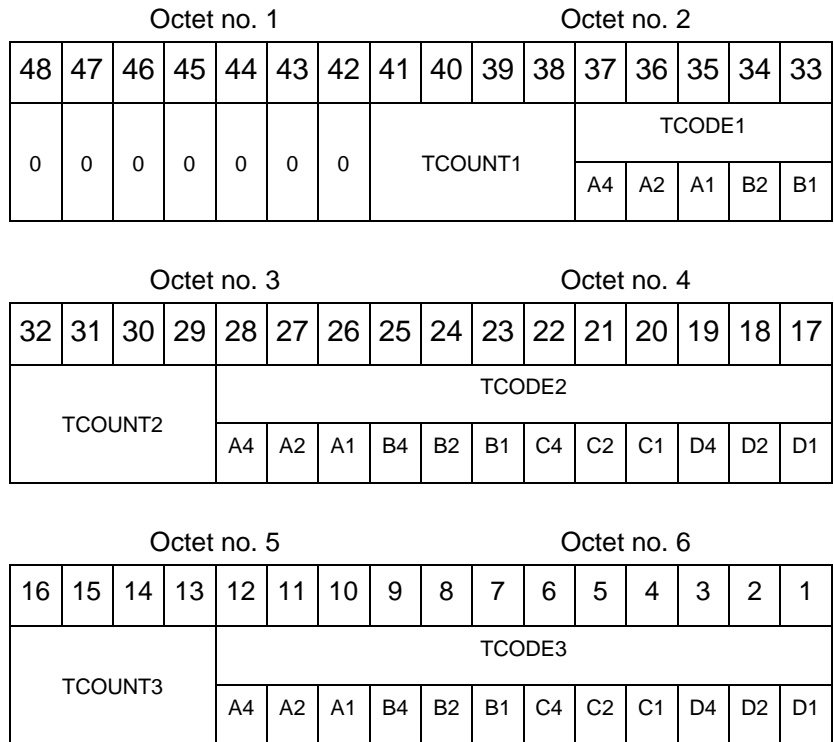
bit-16	(LS)	Lockout State = 0 Target not locked out by this radar = 1 Target locked out by this radar
bits-15/1 bit-1	(LOCTIM) (LSB)	Lockout Time LSB = 1ms

Structure of Subfield #7 of “Radar Track Characteristics”: Transition Codes

Definition: Indication and Counter of Transition Codes for Modes 1, 2, and 3

Format: Six-octet fixed length Data Item.

Structure:



- bits-48/42 (SPARE) Spare bits, set to 0
- bits-41/38 (TCOUNT1) Number of scans with transient Mode 1 Code
- bits-37/33 (TCODE1) Transient Mode 1 Code
- bits-32/29 (TCOUNT2) Number of scans with transient Mode 2 Code
- bits-28/17 (TCODE2) Transient Mode 2 Code
- bits-16/13 (TCOUNT3) Number of scans with transient Mode 3 Code
- bits-12/1 (TCODE3) Transient Mode 3 Code

Encoding Rule :

It **shall** only be sent if at least one TCOUNTX Element is greater than 0.

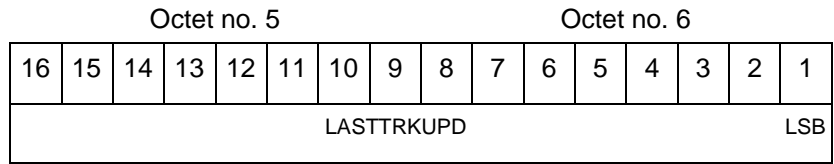
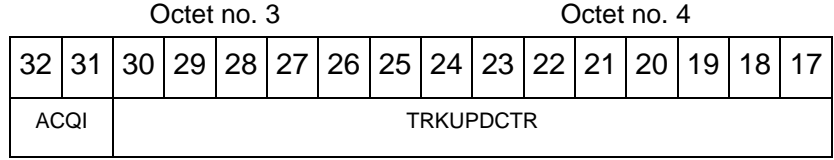
- NOTE:** This item indicates a difference in the value for TCODEX between the code in the track file and the code from the latest plot updating the track.
- NOTE:** If TCOUNTX is set to 0 then TCODEX is meaningless and all bits **shall** be set to 0
- NOTE:** The meaning of the individual bits in TCODEX is described in ICAO Annex 10 Volume 4 Chapter 3.1.1.6.2.

Structure of Subfield #8 of “Radar Track Characteristics”: Track Lifecycle

Definition: Acquisition Status of the Track and Track Life Cycle Counters

Format: Four-octet fixed length Data Item.

Structure:



- bits-32/31 (ACQI) Acquisition Status Indicator
 = 0 Tentative Track with One Plot
 = 1 Tentative Track with at least Two Plots
 = 2 Pre-Confirmed Track
 = 3 Confirmed Track
- bits-30/17 (TRKUPDCTR) Track Update Counter
- bits-16/1 (LASTTRKUPD) Time since last Track Update
- bit-1 (LSB) LSB = 1ms

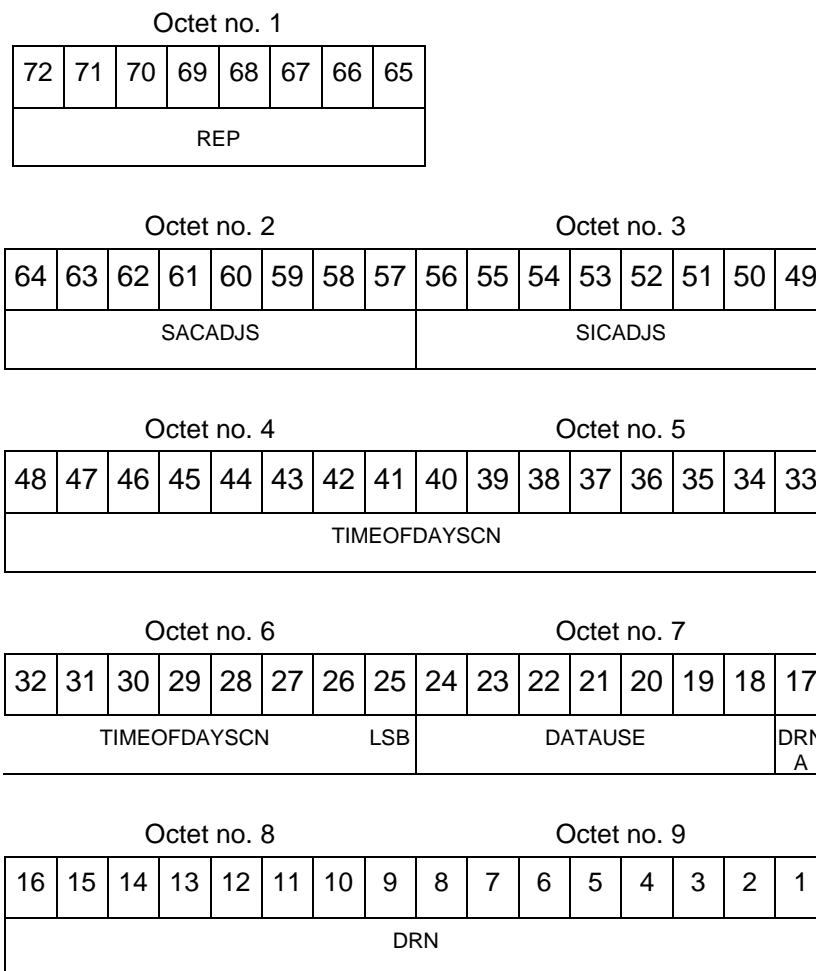
- NOTE:** When Subfield #8 is included, each element **shall** be properly populated.
- NOTE:** The setting of bits 32/31 is implementation dependent and **shall** be described in the ICD of the system generating the ASTERIX record.
- NOTE:** The TRKUPDCTR is initiated with a value of 1 and it is incremented by 1 each time a track is updated.
- NOTE:** The LASTTRKUPD is set to 0 each time a track is updated.

Structure of Subfield #9 of “Radar Track Characteristics”: Adjacent Sensor Information

Definition: Adjacent Sensor information (received via SCN) for the respective Mode S address

Format: Repetitive Data Item starting with a one-octet Field Repetition Indicator followed by at least one Adjacent Sensor Record composed of eight octets.

Structure:



- bits-72/65 (REP) Repetition Factor
- bits-64/57 (SACADJS) SAC of the Adjacent Sensor
- bits-56/49 (SICADJS) SIC of the Adjacent Sensor
- bits-48/25 (TIMEOFDAYSCN) Absolute Timestamp in UTC provided by the SCN
- bit-25 (LSB) LSB = 1/128s

bits-24/18	(DATAUSE)	Use of Adjacent Sensor Data = 0 Data used by Tracker = 1 Data not used by Tracker = 2 – 127 Reserved for future use
bit-17	(DRNA)	DRN Availability = 0 DRN not available = 1 DRN available
bits-16/1	(DRN)	Duplicate Address Reference Number uniquely identifying the aircraft in case of a duplicate Mode S Address.

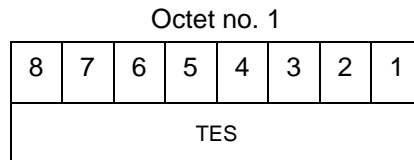
NOTE: When DRNA = 0, DRN **shall** be 0.

Structure of Subfield #10 of “Radar Track Characteristics”: Track Extrapolation Source

Definition: Source for the extrapolation of the track information

Format: One-octet fixed length Data Item.

Structure:



bits-8/1 (TES)

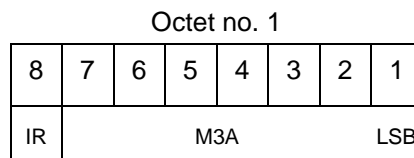
Track Extrapolation Source
 = 0 Radar tracker calculation
 = 1 integrated ADS-B
 = 2 external ADS-B
 = 3 SCN
 = 4 – 255 reserved for future use

Structure of Subfield #11 of “Radar Track Characteristics”: Identity Requested

Definition: information whether during latest scan the Mode 3/A Code was requested

Format: One-octet fixed length Data Item.

Structure:



bit-8 (IR)

Identity Requested during latest scan
 = 0 Identity not requested
 = 1 Identity requested

bits-7/1 (M3A)
 bit-1 (LSB)

Age of Mode 3/A Code (I007/070)
 1s

2.9 Common and Plot Characteristics

Definition: Plot Characteristics and Common Characteristics for Plots and Tracks

Format: Compound Data Item comprising a first part of one-octet extensible, followed by the indicated subfields.

Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
PNB	RPL	SNB	DATE	0	0	0	FX

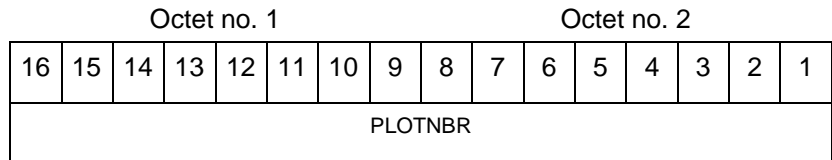
bit-8	(PNB)	Subfield #1: Plot Number =0 Absence of Subfield #1 =1 Presence of Subfield #1
bit-7	(RPL)	Subfield #2: Replies/Plot Link =0 Absence of Subfield #2 =1 Presence of Subfield #2
bit-6	(SNB)	Subfield #3: Scan Number =0 Absence of Subfield #3 =1 Presence of Subfield #3
bit-5	(DATE)	Subfield #4: Date =0 Absence of Subfield #4 =1 Presence of Subfield #4
bits-4/2	(SPARE)	Spare Bits, set to 0
bit-1	(FX)	= 0 End of Primary Subfield = 1 Extension of Primary

Structure of Subfield #1 of “Common and Plot Characteristics”: Plot Number

Definition: Unique reference to a Plot Record

Format: Two-octet fixed length Data Item.

Structure:



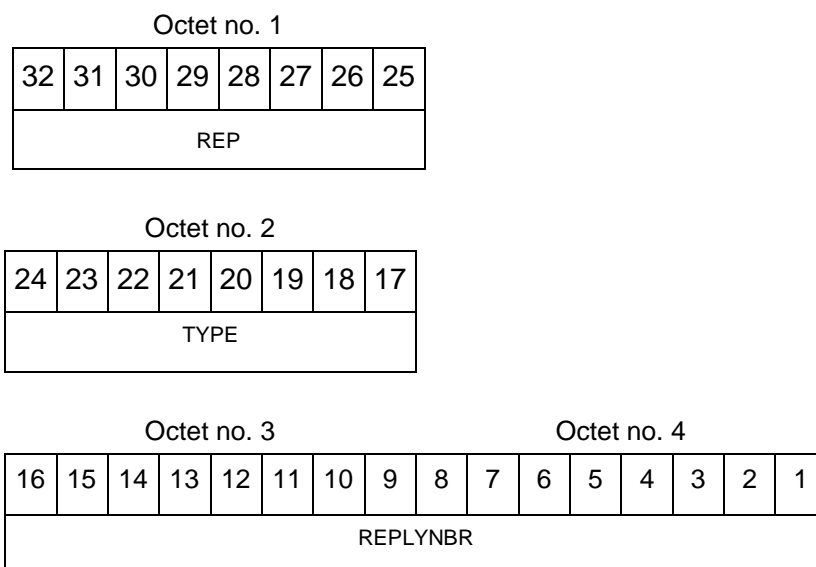
bits-16/1 (PLOTNBR) Unique Identification of a Plot Record

Structure of Subfield #2 of “Common and Plot Characteristics”: Replies / Plot Link

Definition: Link between a Plot and its Replies

Format: Repetitive Data Item starting with a one-octet Field Repetition Indicator followed by at least one Plot/Link Record composed of three octets.

Structure:



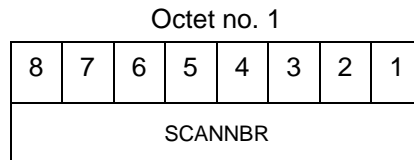
- | | | |
|------------|------------|--|
| bits-32/25 | (REP) | Repetition Factor |
| bits-24/17 | (TYPE) | Reply Type
= 0 PSR Echo
= 1 SSR Reply
= 2 All Call Reply
= 3 Roll Call Reply |
| bits-16/1 | (REPLYNBR) | Unique reference to a plot record |

Structure of Subfield #3 of “Common and Plot Characteristics”: Scan Number

Definition: Scan Number

Format: One-octet fixed length Data Item.

Structure:



bits-8-1 (SCANNBR) Scan Number

NOTE: The Scan Number ranges from 1 to 127 and is incremented when the radar passes North. Once SCANNBR reached 127 it will restart at 1 with the next scan.

Structure of Subfield #4 of “Common and Plot Characteristics”: Date

Definition: Current Date in the form YYYYMMDD

Format: Four-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Y1				Y2				Y3				Y4			

Octet no. 3								Octet no. 4							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
M1				M2				D1				D2			

bits-32/29	(Y1)	First digit of year
bits-28/25	(Y2)	Second digit of year
bits-24/21	(Y3)	Third digit of year
bits-20/17	(Y4)	Fourth digit of year
bits-16/13	(M1)	First digit of month
bits-12/9	(M2)	Second digit of month
bits-8/5	(D1)	First digit of day
bits-4/1	(D2)	Second digit of day

NOTE: The day is incremented at midnight UTC.

2.10 Generic Category 007 Data

Definition: Placeholder for the addition of information to Category 007 even if all bits of the Item Indicator are allocated

Format: Compound Data Item comprising a first part of one-octet extensible, followed by the indicated subfields.

Structure of Primary Subitem of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
ALTM2	ALTM3	ALTFL	0	0	0	0	FX

bit-8 (ALTM2) Subfield #1: Alternative Mode 2
 =0 Absence of Subfield #1
 =1 Presence of Subfield #1

bit-7 (ALTM3) Subfield #2: Alternative Mode 3/A
 =0 Absence of Subfield #2
 =1 Presence of Subfield #2

bit-6 (ALTFL) Subfield #3: Alternative Flight Level
 =0 Absence of Subfield #3
 =1 Presence of Subfield #3

bits-5/2 (SPARE) Spare Bits, set to 0

bit-1 (FX) =0 End of Primary Subfield
 =1 Extension of Primary Subfield

NOTE - The definition of additional subitems to I007/REF/GEN07 is the responsibility of the AMG and **shall** be agreed upon prior to implementation.

Structure of Subitem #1 of “Generic Category 007 Data”: Alternative Mode 2 Code

Definition: Mode 2 Information in octal representation received via an alternative technology as compared to Data Item I007/050.

Format: Two-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	L	0	ALTM2											
				A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1

- bit-16 (V) = 0 Code validated
= 1 Code not validated
- bit-15 (G) = 0 Default
= 1 Garbled code
- bit-14 (L) = 0 Mode-2 code as derived from the reply of the transponder
= 1 Smoothed Mode-2 code as provided by a local tracker
- bit-13 (SPARE) Spare bit set to 0
- bits-12/1 (ALTM2) Mode-2 Code in octal representation

NOTE - For radar systems interrogating with various technologies (such as military radars interrogating in Mode S and Mode 5), this item provides the possibility to transmit an alternative Mode-2 value. The population of this item is implementation dependent and **shall** be described in the System ICD.

Structure of Subitem #2 of “Generic Category 007 Data”: Alternative Mode 3/A

Definition: Mode-3/A Code as received from the transponder via an alternative technology as compared to Data Item I007/070.

Format: Two-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	L	0	ALTM3											
				A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1

- bit-16 (V) = 0 Code validated
= 1 Code not validated
- bit-15 (G) = 0 Default
= 1 Garbled code
- bit-14 (L) = 0 Mode-3/A code as derived from the reply of the transponder
= 1 Smoothed Mode-3/A code as provided by a local tracker
- bit-13 (SPARE) Spare bit set to 0
- bits-12/1 (ALTM3) Mode-3/A code in octal representation

NOTE - For radar systems interrogating with various technologies (such as military radars interrogating in Mode S and Mode 5), this item provides the possibility to transmit an alternative Mode-3/A value. The population of this item is implementation dependent and **shall** be described in the System ICD.

Structure of Subitem #3 of “Generic Category 007 Data”: Alternative Flight Level

Definition: Flight Level derived from an alternative technology as compared to Data Item I007/090, converted into binary representation.

Format: Two-octet fixed length Data Item.

Structure:

Octet no. 1								Octet no. 2							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
V	G	ALTFL										LSB			

bit-16	(V)	= 0	Code validated
		= 1	Code not validated
bit-15	(G)	= 0	Default
		= 1	Garbled code
bits-14/1	(ALTFL)		Flight Level in two's complement form
bit-1	(LSB)		1/4 FL

NOTES

1. When Mode C code is present but not decodable, the “Undecodable Mode C code / Mode S altitude code” Warning/Error should be sent in I007/030.
2. When local tracking is applied and the received Mode C code corresponds to an abnormal value (the variation with the previous plot is estimated too important by the tracker), the “Mode C code / Mode S altitude code abnormal value compared to the track“ Warning/Error should be sent in I007/030.
3. The value shall be within the range described by ICAO Annex 10
4. For radar systems interrogating with various technologies (such as military radars interrogating in Mode S and Mode 5), this item provides the possibility to transmit an alternative Flight Level value. The population of this item is implementation dependent and **shall** be described in the System ICD.

Encoding Rule:

The Reserved Expansion Field is optional. When used to transmit M5N, it shall be sent when at least one of the following conditions is satisfied:

1. The target represented by the Monoradar Target Report has been interrogated in Mode 5.
2. A non-zero Extended Mode 1 Code is received.
3. An X-pulse is present in a Mode 5 reply/report.

If condition 1 is satisfied, then Subfield #1 (Mode 5 Summary) shall be present.

If condition 2 is satisfied then Subfield #5 (Extended Mode 1 Code in Octal Representation) shall be present.

If condition 3 is satisfied, then Subfield #7 (X Pulse Presence) shall be present.



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