

**ASTERIX Part 4**  
**Category 048**  
**Appendix A**  
**Coding rules for**  
**"Reserved Expansion**  
**Field"**



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The following table identifies all management authorities who have successively approved the present issue of this document.

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## EXECUTIVE SUMMARY

## **1. INTRODUCTION**

### **1.1 Scope**

This document describes the way to encode information in the Reserved Expansion Field of Monoradar Target Report from ASTERIX Cat 048.



## 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 itself)

**Format :** One-octet fixed length Data Item

**Structure:**

Octet no. 1							
8	7	6	5	4	3	2	1
LEN							

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
MD5	0	0	0	0	0	0	0

bits 8 (MD5) = 0 Mode 5 Data/Reports, Extended Mode 1 Code and X Pulse are not present in the REF

= 1 Mode 5 Data/Reports and Extended Mode 1 Code and X Pulse are present in the REF

bits 7/1 Spare bits set to 0

**Encoding Rule :**

This item shall be present in every REF

## 2.3 MD5

**Definition:** Mode 5 Data/Reports, Extended Mode 1 Code and X pulse

**Format:** Compound data item comprising one primary subfield of one octet, followed by up to 7 subfields

### Structure of Primary Subfield of Compound Data Item:

Octet no. 1							
8	7	6	5	4	3	2	1
SUM	PMN	POS	GA	EM1	TOS	XP	FX

bit-8, octet 1 (SUM) Subfield #1: Mode 5 Summary  
 =0 Absence of Subfield #1  
 =1 Presence of Subfield #1

bit-7, octet 1 (PMN) Subfield #2: Mode 5 PIN/ National Origin/Mission Code  
 =0 Absence of Subfield #2  
 =1 Presence of Subfield #2

bit-6, octet 1 (POS) Subfield #3: Mode 5 Reported Position  
 =0 Absence of Subfield #3  
 =1 Presence of Subfield #3

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

bit-4, octet 1 (EM1) Subfield #5: Extended Mode 1 Code in Octal Representation  
 =0 Absence of Subfield #5  
 =1 Presence of Subfield #5

bit-3, octet 1 (TOS) Subfield #6: Time Offset for POS and GA.  
 =0 Absence of Subfield #6  
 =1 Presence of Subfield #6

bit-2, octet 1 (XP) Subfield #7: X Pulse Presence  
 =0 Absence of Subfield #7  
 =1 Presence of Subfield #7

bit-1, octet 1 (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  
= 1 Authenticated Mode 5 ID reply

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  
= 1 Mode 1 code from Mode 5 reply.

bit-4 (M2) = 0 Mode 2 code not present or not from Mode 5 reply  
= 1 Mode 2 code from Mode 5 reply.

bit-3 (M3) = 0 Mode 3 code not present or not from Mode 5 reply  
= 1 Mode 3 code from Mode 5 reply.

bit-2 (MC) = 0 Mode C altitude not present or not from Mode 5 reply  
= 1 Mode C altitude from Mode 5 reply

bit-1 Spare bit set to 0

**Notes:**

1. The flags M2, M3, MC refer to the contents of data items I048/050, I048/070 and I048/090 respectively. The flag M1 refers to the contents of data item I048/055, 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 is received with the Emergency bit set, then the Military Emergency bit (ME) in Data Item I048/020, Target Report Descriptor, shall be set.
3. If an authenticated Mode 5 reply is received with the Identification of Position bit set, then the Special Position Identification bit (SPI) in Data Item I048/020, Target Report Descriptor, shall be set.

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

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	NAT (LSB)					0	0	MIS (LSB)					

bits-32/31 (spare) spare bits set to 0

bits-30/17 (PIN) PIN Code

bits-16/14 (spare) spare bits set to 0

bits-13/9 (NAT) National Origin

bits-8/7 (spare) spare bits set to 0

bits-6/1 (MIS) Mission Code

**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
0	0	0	0	Extended Mode 1 Code											
				A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1

bit 16/13 Spare bits set to 0

bits-12/1 (EM1)

Extended Mode 1 Code in octal representation

**Note:** 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.

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

Octet no. 1							
8	7	6	5	4	3	2	1
TOS (LSB)							

bits-8/1 (TOS)

Time Offset coded as a two's 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 (I048/140) 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	0	X5	XC	X3	X2	X1

bits-8/6 spare bits set to zero

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)

**Encoding Rule:**

The Reserved Expansion Field is optional. When used to transmit MD5, 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.

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.