# EUROCONTROL Specification for Surveillance Data Exchange ASTERIX Part 12 Category 21 Appendix A Reserved Expansion Field

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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 refer to Part 1.

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# **DOCUMENT CHANGE RECORD**

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

EDITION NUMBER	EDITION DATE	REASON FOR CHANGE	PAGES AFFECTED
1.0	March 2011	Creation & internal working document	All
1.1	May 2011	Alignment with SPI-IR and DO260B enhancements	All
1.2	June 2014	EUROCONTROL Specification Layout Military Extended Squitter added Editorial updates & corrections	All MES SGV / TNH
1.3	September 2015	Corrections to field MES	MES
1.4	March 2018	Document Identifier corrected	ii

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# 1. INTRODUCTION

# 1.1 Scope

This document describes the way to encode information in the Reserved Expansion Field of ASTERIX Cat 021 (ADS-B Target Reports).

# 2. DESCRIPTION OF THE CONTENT OF RESERVED EXPANSION FIELD

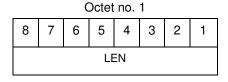
# 2.1 Length Indicator

**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												
BPS	SelH	NAV	GAO	SGV	STA	TNH	MES					

BPS	SelH	NAV	GAO	SGV	STA	TNH	MES	
	_	I						
bi	t 8			(BF	PS)		= 0	Barometric Pressure Setting is not present in the REF
							= 1	Barometric Pressure Setting is present in the REF
bi	t 7			(Se	elH)		= 0	Selected Heading is not present in the REF
							= 1	Selected Heading is present in the REF
bi	t 6			(N	AV)		= 0	Navigation Mode is not present in the REF
							= 1	Navigation Mode is present in the REF
bi	t 5			(G	AO)		= 0	GPS Antenna Offset is not present in the REF
							= 1	GPS Antenna Offset is present in the REF
bi	t 4			(SC	GV)		= 0	Surface Ground Vector is not present in the REF
							= 1	Surface Ground Vector is present in the REF
bi	t 3			(S	ΓΑ)		= 0	Aircraft Status Information is not present in the REF
							= 1	Aircraft Status Information is present in the REF
bi	t 2			(T)	NH)		= 0	True North Heading is not present in the REF
							= 1	True North Heading is present in the REF
bi	t 1			(M	ES)		= 0	Military Extended Squitters is not present in the REF
							= 1	Military Extended Squitters is present in the REF

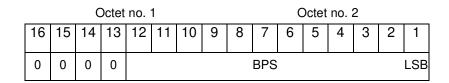
# **Encoding Rule:**

This item shall be present in every REF

# 2.3 Barometric Pressure Setting 'BPS'

**Definition**: Barometric Pressure Setting **Format**: 2-Octet fixed length data item.

Structure:



bits-16/13 Spare bits, set to "0"

bits-12/1 (BPS) Barometric Pressure Setting

LSB = 0.1 hPa

 $0mb \le BPS \le 409.5 hPa$ 

**NOTE -** BPS is the barometric pressure setting of the aircraft minus 800 hPa.

**NOTE** - A value of "0" indicates that in the aircraft a value of 800 hPa or less has been selected.

**NOTE -** A value of "409.5" indicates that in the aircraft a value of 1209.5 hPa or more has been selected.

## 2.4 Selected Heading 'SelH'

**Definition**: Selected Heading

**Format**: 2-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
0	0	0	0	HRD	Stat	SelH							LSB		

bits-16/13 Spare bits, set to "0"

bit-12 (HRD) Horizontal Reference Direction

0 = True North 1 = Magnetic North

bit-11 (Stat) Selected Heading Status

0 = Data is either unavailable or invalid.

1 = Data is available and valid.

bits-10/1 (SelH) Selected Heading

LSB = 0.703125

**NOTE:** On many aircraft, the ADS-B Transmitting Subsystem receives

Selected Heading from a Mode Control Panel / Flight Control Unit (MCP / FCU). Users of this data are cautioned that the Selected Heading value transmitted by the ADS-B Transmitting Subsystem does not necessarily reflect the true intention of the airplane during

certain flight modes (e.g., during LNAV mode).

# 2.5 Navigation Mode 'NAV'

**Definition**: Navigation Mode Settings

Format: 1-Octet fixed length data item.

Structure:

Octet no. 1

8 7 6 5 4 3 2 1

AP VN AH AM 0 0 0 0 0

bit-8	(AP)	=1	Autopilot engaged
bit-7	(VN)	=1	VNAV Active (Vertical Navigation)
bit-6	(AH)	=1	Altitude Hold engaged
bit-5	(AM)	=1	Approach Mode active

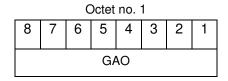
**NOTE:** This data-item should only be transmitted if an ADS-B indication has been received that the mode bits have been "actively populated".by the avionics (1090 ES version 2 (as defined in I021/210) BDS 6,2, subtype 1, bit 47: "Status of MCP / FCU Mode Bits")

## 2.6 GPS Antenna Offset 'GAO'

**Definition**: GPS Antenna Offset

**Format**: 1-Octet fixed length data item.

Structure:



bits-8/1 (GAO) GPS Antenna Offset

NOTE: The value of this field is copied from the respective bits 33-40 of

version 2 (as defined in I021/210) of 1090 ES BDS register 6,5

(Aircraft Operational Status)

# 2.7 Surface Ground Vector 'SGV'

**Definition**: Ground Speed and Track Angle elements of the Surface

Ground Vector.

Format: Variable Length Data Item, comprising a primary subfield of

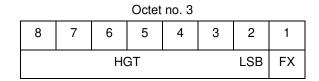
two octets, followed by one-octet extensions as necessary.

# **Structure of Primary Subfield**

			Octet	no. 1			Octet no. 2								
16 15 14 13 12 11 10 9 8								8	7	6	5	4	3	2	1
STP	HTS	HTT	HRD					GS	SS					LSB	FX
	= 0 Aircraft has not stopped														
	<ul><li>= 1 Aircraft has stopped</li><li>= 0 Heading/Ground Track data is not valid</li></ul>														
	bit-15 (HTS)						leadin	g/Grou	nd Tra	ck dat	a is va	lid			
		bit-1	4	(H	ΓΤ)	= 0 Heading data provided									
						= 1 Ground Track provided									
		bit-1	3	(HF	RD)	= 0 T	rue No	orth							
						= 1 Magnetic North									
bits-12/2 (GSS)						Ground speed									
						LSB = 0.125 kts									
bit-1 FX-bit =							nd of I	Data It	em						

= 1 Extension into first extension

#### Structure of First Extension



bits-8/2 (HGT) Heading/Ground Track information

LSB: 2.8125 degrees

bit-1 FX-bit = 0 End of Data Item

= 1 Extension into second extension

Encoding Rule: This item is optional

#### 2.8 Aircraft Status 'STA'

**Definition:** This item contains flags to convey information on the status

of a target.

Format: Variable Length Data Item, comprising a primary subfield of

one octet, followed by one-octet extensions as necessary.

## Structure of Primary Subfield

Octet no. 1

8	7	6	5	4	3	2	1
ES	UAT	0	0	0	0	0	FX

bit-8 (ES) = 0Target is not 1090 ES IN capable

> = 1 Target is 1090 ES IN capable

bit-7 (UAT) = 0Target is not UAT IN capable

> = 1 Target is UAT IN capable

bits-6/2 Spare bits set to 0 spare

bit-1 FX-bit End of Data Item = 0

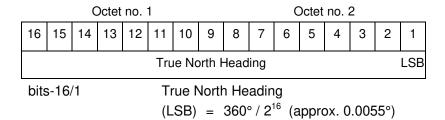
> = 1 Extension into second subfield

# 2.9 True North Heading 'TNH'

**Definition**: True North Heading (Element of Air Vector).

**Format**: Two-Octet fixed length data item.

# **Structure of Primary Subfield**



**NOTE -** Magnetic Heading is defined in I021/152.

# 2.10 Military Extended Squitter 'MES'

**Definition:** Contents of Extended Squitters transmitted by Military Aircraft

Format: Compound data item comprising of a primary subfield of one

octet extensible, followed by the indicated subfields.

**NOTE:** The information contained in this data item is specific to

1090MHz Extended Squitter messages transmitted by military

aircraft (Mode 5 Level 2 squitter).

# Structure of Primary Subfield of Compound Data Item:

$\sim$	-1-1	
( )	ctet	nΛ
$\sim$	וסוטי	HU.

8	/	ь	5	4	3	2	1	
SUM	PNO	EM1	XP	FOM	M2	0	FX	
bit-8		(S	UM)		Subfi	ode 5 Summary		
								ofield #1 Ibfield #1
bit-7		(P <b>1</b>	NO)	_	Natio Abse	onal nce	Origin of Sul	ode 5 PIN/ I ofield #2 Ibfield #2
bit-6		(EN	M1)	=0 =1	Code Abse	ktended Mode 1 Representation bfield #3 ubfield #3		
bit-5		(XF	P)	=0 =1	Abse	ence	of Su	Pulse Presence bfield #4 ubfield #4
bit-4		(F	OM)		Subfi	eld <del>i</del>	#5: Fig	gure of Merit
				_				ofield #5 ubfield #5
bit-3		(M	2)	=0 =1	Abse	ence	of Su	ode 2 Code bfield #6 ubfield #6
bit-2		(sp	are)		Spai	e bi	t, set t	o "0"
bit-1		(F)	<)				-	Subfield

# Structure of Subfield #1: Mode 5 Summary:

Octet no. 1

		,	Jule	110.	l			
8	7	6	5	4	3	2	1	
M5	ID	DA	M1	M2	МЗ	МС	РО	
bit-8		(N	15)					Node 5 interrogation  in 5 interrogation
bit-7		(II)	<b>)</b>				reply Auth	uthenticated Mode 5 ID //report enticated Mode 5 ID //report
bit-6		([	OA)				reply Auth reply	authenticated Mode 5 Data or Report nenticated Mode 5 Data or Report (i.e any valid e 5 reply type other than
bit-5	from Mode 5				e 1 code not present or not Mode 5 reply/report e 1 code from Mode 5 //report.			
bit-4		(N	12)				from Mode	e 2 code not present or not Mode 5 reply/report e 2 code from Mode 5 //report.
bit-3		(N	<b>1</b> 3)				from Mode	e 3 code not present or not Mode 5 reply/report e 3 code from Mode 5 //report.
bit-2		(N	(IC)			fr 1 Fl ₃	rom N lightle	evel not present or not Mode 5 reply/report evel from Mode 5 report
bit-1		(F	PO)			()	ADS-	on not from Mode 5 report B report) on from Mode 5 report

#### Notes:

- 1. The flag M2 refers to the contents of Subfield #6 below, M3, MC refer to the contents of data items I021/070 and I021/145 respectively. The flag M1 refers to the contents of Subfield #3 below (Extended Mode 1 Code in Octal Representation).
- 2. If a Mode 5 reply/report is received with the Emergency bit set, then the Military Emergency bit (ME) in Data Item I021/200, Target Status, shall be set.
- 3. If a Mode 5 reply/report is received with the Identification of Position bit set, then the Special Position Identification bit (SPI) in Data Item I021/200, Target Status, shall be set.
- 4. If a Mode 5 report (ID or Data) is received and fullfill the autentication criteria the corresponding authentication bit shall be set.

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

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

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

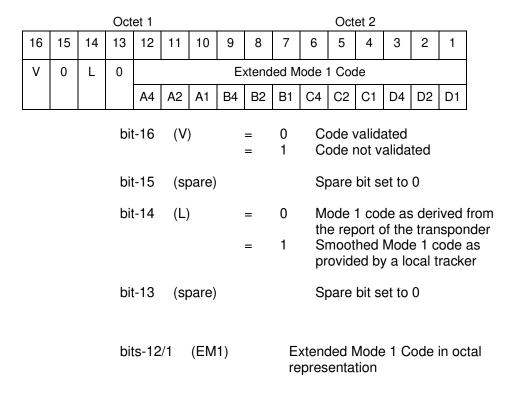
anara hita aat ta 0

DIIS-32/3 I	(Spare)	spare bits set to 0
bits-30/17	(PIN)	PIN Code
bits-16/12	(spare)	spare bits set to 0
bits-11/1	(NO)	National Origin Code

hite\_32/31 (cnare)

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### Structure of Subfield #3: 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.

Note: If Subfield #3 is not present the Mode 1 Code was not reported or all

Code Bits were equal to 0.

Note: The valid bit is set if the Code was only reported once for that target.

# **Structure of Subfield #4 of Compound Data Item:** X Pulse Presence

Octet no. 1												
3	7	6	5	4	3	2	1					
)	0	XP	X5	XC	Х3	X2	X1					

bits-8/7	spare bits set to z	ero
bit-6	(XP)	<ul><li>X-pulse from Mode 5 PIN reply/report</li><li>= 0 X-Pulse not present.</li><li>= 1 X-pulse present.</li></ul>
bit-5	(X5)	<ul> <li>X-pulse from Mode 5 Data reply or Report.</li> <li>= 0 X-pulse set to zero or no authenticated Data reply or Report received.</li> <li>= 1 X-pulse set to one (present).</li> </ul>
bit-4	(XC)	<ul><li>X-pulse from Mode C reply</li><li>0 X-pulse set to zero or no Mode C reply</li><li>1 X-pulse set to one (present)</li></ul>
bit-3	(X3)	<ul><li>X-pulse from Mode 3/A reply</li><li>0 X-pulse set to zero or no Mode 3/A reply</li><li>1 X-pulse set to one (present)</li></ul>
bit-2	(X2)	<ul><li>X-pulse from Mode 2 reply</li><li>0 X-pulse set to zero or no Mode 2 reply</li><li>1 X-pulse set to one (present)</li></ul>
bit-1	(X1)	<ul><li>X-pulse from Mode 1 reply</li><li>0 X-pulse set to zero or no Mode 1 reply</li><li>1 X-pulse set to one (present)</li></ul>

## NOTE to Subfield #4 (X Pulse Presence):

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

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

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# Structure of Subfield #5 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

# Structure of Subfield #6 of Compound Data Item: Mode 2 Code in Octal Representation

Octet no. 1										C	Octet	no.	2		
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
٧	0	L	0	A4	A2	A1	B4	B2	B1	C4	C2	C1	D4	D2	D1
bit-	bit-16 (V) = 0 Code validated = 1 Code not validated bit-15 Spare bit set to 0 bit-14 (L) = 0 Mode-2 code as derived from the reply of the								ed						
						=	1	transponder						8	
bit-13						S	oare	bit	set t	0 0					
bits-12/1									ode atior		ctal				

**Note:** If Subfield 6 is not present the Mode 2 Code was no reported or all Code Bits were equal to 0.

# **Encoding Rule applying to the full Reserved Expansion Field:**

The Reserved Expansion Field is optional. When used to transmit MES, it shall be sent when the targets are represented by Mode 5 Level 2 reports.