

# Asterix category 048 - Monoradar Target Reports

**category:** 048

**edition:** 1.31

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## Preamble

Surveillance data exchange.

## Description of standard data items

### I048/010 - Data Source Identifier

*Definition:* Identification of the radar station from which the data is received.

*Structure:*

#### **I048/010/SAC** - *System Area Code*

- 8 bits [ . . . . . ]
- raw value

#### **I048/010/SIC** - *System Identification Code*

- 8 bits [ . . . . . ]
- raw value

#### **Note:**

- The up-to-date list of SACs is published on the EUROCONTROL Web Site (<http://www.eurocontrol.int/asterix>).

### I048/020 - Target Report Descriptor

*Definition:* Type and properties of the target report.

*Structure:*

Extended item.

#### **I048/020/TYP**

- 3 bits [ . . . ]
- values:
  - 0: No detection
  - 1: Single PSR detection
  - 2: Single SSR detection
  - 3: SSR + PSR detection
  - 4: Single ModeS All-Call
  - 5: Single ModeS Roll-Call
  - 6: ModeS All-Call + PSR
  - 7: ModeS Roll-Call +PSR

#### **I048/020/SIM**

- 1 bit [ . ]
- values:

- 0: Actual target report
- 1: Simulated target report

#### **I048/020/RDP**

- 1 bit [.]
- values:
  - 0: Report from RDP Chain 1
  - 1: Report from RDP Chain 2

#### **I048/020/SPI**

- 1 bit [.]
- values:
  - 0: Absence of SPI
  - 1: Special Position Identification

#### **I048/020/RAB**

- 1 bit [.]
- values:
  - 0: Report from aircraft transponder
  - 1: Report from field monitor (fixed transponder)

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

#### **I048/020/TST**

- 1 bit [.]
- values:
  - 0: Real target report
  - 1: Test target report

#### **I048/020/ERR**

- 1 bit [.]
- values:
  - 0: No Extended Range
  - 1: Extended Range present

#### **I048/020/XPP**

- 1 bit [.]
- values:
  - 0: No X-Pulse present
  - 1: X-Pulse present

#### **I048/020/ME**

- 1 bit [.]
- values:
  - 0: No military emergency
  - 1: Military emergency

#### **I048/020/MI**

- 1 bit [.]
- values:
  - 0: No military identification
  - 1: Military identification

#### **I048/020/FOEFRI**

- 2 bits [..]
- values:
  - 0: No Mode 4 interrogation
  - 1: Friendly target
  - 2: Unknown target
  - 3: No reply

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

#### **I048/020/ADSB - On-Site ADS-B Information**

##### **I048/020/ADSB/EP - ADSB Element Populated Bit**

- 1 bit [.]
- values:
  - 0: ADSB not populated
  - 1: ADSB populated

##### **I048/020/ADSB/VAL - On-Site ADS-B Information**

- 1 bit [.]
- values:
  - 0: Not available
  - 1: Available

#### **I048/020/SCN - Surveillance Cluster Network Information**

##### **I048/020/SCN/EP - SCN Element Populated Bit**

- 1 bit [.]
- values:
  - 0: SCN not populated
  - 1: SCN populated

##### **I048/020/SCN/VAL - Surveillance Cluster Network Information**

- 1 bit [.]
- values:
  - 0: Not available
  - 1: Available

#### **I048/020/PAI - Passive Acquisition Interface Information**

##### **I048/020/PAI/EP - PAI Element Populated Bit**

- 1 bit [.]
- values:
  - 0: PAI not populated
  - 1: PAI populated

##### **I048/020/PAI/VAL - Passive Acquisition Interface Information**

- 1 bit [.]
- values:

0: Not available  
1: Available

### **I048/020/(spare)**

- 1 bit [.]

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

Notes:

1. For Mode S aircraft, the SPI information is also contained in I048/230.
2. To bits 3/2 of extension 1 (FOE/FRI): IFF interrogators supporting a three level classification of the processing of the Mode 4 interrogation result shall encode the detailed response information in data item M4E of the Reserved Expansion Field of category 048. In this case the value for FOE/FRI in I048/020 shall be set to "00". However, even those interrogators shall use I048/020 to encode the information "No reply".
3. To bit 6 of extension 1 (XPP): This bit shall always be set when the X-pulse has been extracted, independent from the Mode it was extracted with.
4. To bit 7 of extension 1 (ERR): This bit set to "1" indicates that the range of the target is beyond the maximum range in data item I048/040. In this case - and this case only - the ERR Data Item in the Reserved Expansion Field shall provide the range value of the Measured Position in Polar Coordinates.
5. To Extension 2: The EUROCONTROL Specification for European Mode S Stations Edition 4.0 (EMS 4.0) [Ref. 4] defines new functionalities that can use external data inputs. The possibilities described in EMS 4.0 cover the presence of target information acquired via the on-site ADS-B, the Surveillance Cluster Network or the Passive Acquisition Interface. The second extension provides information - per target - on whether such information is available supporting performance improvements, e.g. Passive Acquisition, and new features, e.g. detection of a potential IC Conflict.

### **I048/030 - Warning/Error Conditions and Target Classification**

*Definition:* Warning/error conditions detected by a radar station for the target report involved. Target Classification information for the target involved.

*Structure:*

Repetitive item with FX extension

- 7 bits [ . . . . . ]
- values:
  - 0: Not defined; never used
  - 1: Multipath Reply (Reflection)
  - 2: Reply due to sidelobe interrogation/reception
  - 3: Split plot
  - 4: Second time around reply
  - 5: Angel
  - 6: Slow moving target correlated with road infrastructure (terrestrial vehicle)
  - 7: Fixed PSR plot
  - 8: Slow PSR target
  - 9: Low quality PSR plot
  - 10: Phantom SSR plot

- 11: Non-Matching Mode-3/A Code
- 12: Mode C code / Mode S altitude code abnormal value compared to the track
- 13: Target in Clutter Area
- 14: Maximum Doppler Response in Zero Filter
- 15: Transponder anomaly detected
- 16: Duplicated or Illegal Mode S Aircraft Address
- 17: Mode S error correction applied
- 18: Undecodable Mode C code / Mode S altitude code
- 19: Birds
- 20: Flock of Birds
- 21: Mode-1 was present in original reply
- 22: Mode-2 was present in original reply
- 23: Plot potentially caused by Wind Turbine
- 24: Helicopter
- 25: Maximum number of re-interrogations reached (surveillance information)
- 26: Maximum number of re-interrogations reached (BDS Extractions)
- 27: BDS Overlay Incoherence
- 28: Potential BDS Swap Detected
- 29: Track Update in the Zenithal Gap
- 30: Mode S Track re-acquired
- 31: Duplicated Mode 5 Pair NO/PIN detected
- 32: Wrong DF reply format detected
- 33: Transponder anomaly (MS XPD replies with Mode A/C to Mode A/C-only all-call)
- 34: Transponder anomaly (SI capability report wrong)
- 35: Potential IC Conflict
- 36: IC Conflict detection possible-no conflict currently detected

Notes:

1. It has to be stressed that a series of one or more codes can be reported per target report.
2. Data conveyed in this item are of secondary importance, and can generally also be derived from the processing of mandatory items.
3. As of Edition 1.28 of this specification it is possible to indicate specific Transponder Anomalies by means of dedicated Codes (such as Codes 33 and 34). Code 15 is kept for backwards compatibility. It needs to be understood that ASTERIX Encoders implementing Category 048 in line with Edition 1.27 or earlier of this specification cannot indicate specific Transponder Anomalies.
4. Values 25 to 30 have been defined to comply with the updated European Mode S Specification (EMS) and to provide the possibility to report the following information:
  - Code 25: the maximum number of permitted re-interrogations to acquire the surveillance information has been reached;
  - Code 26: the maximum number of permitted re-interrogations to extract BDS Registers has been reached;
  - Code 27: inconsistency detected between the contents of the message and the BDS register overlayed;
  - Code 28: a BDS swap has been detected and the respective information has been discarded;
  - Code 29: the track has been updated while being in the zenithal gap (also referred to as "Cone of Silence");
  - Code 30: the radar had lost track of an aircraft and subsequently re-acquired it.
  - Code 31: ???
  - Code 32: the transponder has used a wrong Downlink Format.
  - Code 33 & 34: reporting specific Transponder Anomalies.

- Code 35 indicates that a plot has been obtained despite a high probability of an IC Conflict with another interrogator.
  - Code 36 indicates that a plot is in a configuration that it would be possible to detect an IC Conflict with another interrogator. Currently no potential IC Conflict has been detected. NOTE: Although implementation dependent, the use of this code should be limited to the target acquisition phase.
5. Together with Codes 35 and 36 the possibility to communicate the area within which the detection of an IC Conflict is possible was implemented in the Category 034 Specification Ref. [5] by means of Message Type 008.
  6. The use of this Data Item is implementation specific and shall be described in the ICD of the system generating the Category 048 target reports.

## **I048/040 - Measured Position in Polar Co-ordinates**

*Definition:* Measured position of an aircraft in local polar co-ordinates.

*Structure:*

### **I048/040/RHO**

- 16 bits [.....]
- unsigned quantity
- scaling factor: 1
- fractional bits: 8
- unit: "NM"
- $\text{LSB} = 1/2^8 \text{ NM} = 1/256 \text{ NM} \approx 3.90625e - 3 \text{ NM}$
- value  $< 256 \text{ NM}$

### **I048/040/THETA**

- 16 bits [.....]
- unsigned quantity
- scaling factor: 360
- fractional bits: 16
- unit: "°"
- $\text{LSB} = 360/2^{16} \text{ °} = 360/65536 \text{ °} \approx 5.4931640625e - 3 \text{ °}$

Notes:

1. In case of no detection, the extrapolated position expressed in slant polar co-ordinates may be sent, except for a track cancellation message. No detection is signalled by the TYP field set to zero in I048/020 Target Report Descriptor.
2. 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.
3. In case of combined detection by a PSR and an SSR, then the SSR position is sent.
4. For targets having a range beyond the maximum range the data item "Extended Range Report" has been added to the Reserved Expansion Field of category 048. The presence of this data item is indicated by the ERR bit set to one in data item I048/020, first extension. The ERR data item shall only be sent if the value of RHO is equal to or greater than 256NM. Please note that if this data item is used, the Encoding Rule to data item I048/040 still applies, meaning that the extra item in the Reserved Expansion Field shall be transmitted in addition to data item I048/040. If the Extended Range Report item in the Reserved Expansion Field is used, it is recommended to set the value of RHO in data item I048/040 to its maximum, meaning bits 32/17 all set to 1.

## **I048/042 - Calculated Position in Cartesian Co-ordinates**

*Definition:* Calculated position of an aircraft in Cartesian co-ordinates.

*Structure:*

### **I048/042/X - X-Component**

- 16 bits [.....]
- signed quantity
- scaling factor: 1
- fractional bits: 7
- unit: "NM"
- $\text{LSB} = 1/2^7 \text{ NM} = 1/128 \text{ NM} \approx 7.8125e - 3 \text{ NM}$
- value  $\geq -256 \text{ NM}$
- value  $\leq 256 \text{ NM}$

### **I048/042/Y - Y-Component**

- 16 bits [.....]
- signed quantity
- scaling factor: 1
- fractional bits: 7
- unit: "NM"
- $\text{LSB} = 1/2^7 \text{ NM} = 1/128 \text{ NM} \approx 7.8125e - 3 \text{ NM}$
- value  $\geq -256 \text{ NM}$
- value  $\leq 256 \text{ NM}$

## **I048/050 - Mode-2 Code in Octal Representation**

*Definition:* Reply to Mode-2 interrogation.

*Structure:*

### **I048/050/V**

- 1 bit [.]
- values:
  - 0: Code validated
  - 1: Code not validated

### **I048/050/G**

- 1 bit [.]
- values:
  - 0: Default
  - 1: Garbled code

### **I048/050/L**

- 1 bit [.]
- values:
  - 0: Mode-2 code as derived from the reply of the transponder
  - 1: Smoothed Mode-2 code as provided by a local tracker

### **I048/050/(spare)**

- 1 bit [.]

### **I048/050/MODE2 - Mode-2 Code in Octal Representation**

- 12 bits [ . . . . . ]
- Octal string (3-bits per digit)

**Note:**

- Bit 15 has no meaning in the case of a smoothed Mode-2 and is set to 0 for a calculated track.

**I048/055 - Mode-1 Code in Octal Representation**

*Definition:* Reply to Mode-1 interrogation.

*Structure:*

**I048/055/V**

- 1 bit [.]
- values:
  - 0: Code validated
  - 1: Code not validated

**I048/055/G**

- 1 bit [.]
- values:
  - 0: Default
  - 1: Garbled code

**I048/055/L**

- 1 bit [.]
- values:
  - 0: Mode-1 code as derived from the reply of the transponder
  - 1: Smoothed Mode-1 code as provided by a local tracker

**I048/055/MODE1 - Mode-1 Code**

- 5 bits [ . . . . ]
- raw value

*Notes:*

1. Bit 7 has no meaning in the case of a smoothed Mode-1 and is set to 0 for a calculated track.
2. 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 subfield #5 of data item "MD5 - Mode 5 Reports" and in subfield #5 of data item "MD5 - Mode 5 Reports, New Format" in the Reserved Expansion Field.

**I048/060 - Mode-2 Code Confidence Indicator**

*Definition:* Confidence level for each bit of a Mode-2 reply as provided by a monopulse SSR station.

*Structure:*

**I048/060/(spare)**

- 4 bits [ . . . ]



**I048/060/QA4**

- 1 bit [.]
- values:
  - 0: High quality pulse A4
  - 1: Low quality pulse A4

**I048/060/QA2**

- 1 bit [.]
- values:
  - 0: High quality pulse A2
  - 1: Low quality pulse A2

**I048/060/QA1**

- 1 bit [.]
- values:
  - 0: High quality pulse A1
  - 1: Low quality pulse A1

**I048/060/QB4**

- 1 bit [.]
- values:
  - 0: High quality pulse B4
  - 1: Low quality pulse B4

**I048/060/QB2**

- 1 bit [.]
- values:
  - 0: High quality pulse B2
  - 1: Low quality pulse B2

**I048/060/QB1**

- 1 bit [.]
- values:
  - 0: High quality pulse B1
  - 1: Low quality pulse B1

**I048/060/QC4**

- 1 bit [.]
- values:
  - 0: High quality pulse C4
  - 1: Low quality pulse C4

**I048/060/QC2**

- 1 bit [.]
- values:
  - 0: High quality pulse C2
  - 1: Low quality pulse C2

**I048/060/QC1**

- 1 bit [.]

- values:
  - 0: High quality pulse C1
  - 1: Low quality pulse C1

#### **I048/060/QD4**

- 1 bit [.]
- values:
  - 0: High quality pulse D4
  - 1: Low quality pulse D4

#### **I048/060/QD2**

- 1 bit [.]
- values:
  - 0: High quality pulse D2
  - 1: Low quality pulse D2

#### **I048/060/QD1**

- 1 bit [.]
- values:
  - 0: High quality pulse D1
  - 1: Low quality pulse D1

### **I048/065 - Mode-1 Code Confidence Indicator**

*Definition:* Confidence level for each bit of a Mode-1 reply as provided by a monopulse SSR station.

*Structure:*

#### **I048/065/(spare)**

- 3 bits [...]

#### **I048/065/QA4**

- 1 bit [.]
- values:
  - 0: High quality pulse A4
  - 1: Low quality pulse A4

#### **I048/065/QA2**

- 1 bit [.]
- values:
  - 0: High quality pulse A2
  - 1: Low quality pulse A2

#### **I048/065/QA1**

- 1 bit [.]
- values:
  - 0: High quality pulse A1
  - 1: Low quality pulse A1

#### **I048/065/QB2**

- 1 bit [.]
- values:
  - 0: High quality pulse B2
  - 1: Low quality pulse B2

#### **I048/065/QB1**

- 1 bit [.]
- values:
  - 0: High quality pulse B1
  - 1: Low quality pulse B1

### **I048/070 - Mode-3/A Code in Octal Representation**

*Definition:* Mode-3/A code converted into octal representation.

*Structure:*

#### **I048/070/V**

- 1 bit [.]
- values:
  - 0: Code validated
  - 1: Code not validated

#### **I048/070/G**

- 1 bit [.]
- values:
  - 0: Default
  - 1: Garbled code

#### **I048/070/L**

- 1 bit [.]
- values:
  - 0: Mode-3/A code derived from the reply of the transponder
  - 1: Mode-3/A code not extracted during the last scan

#### **I048/070/(spare)**

- 1 bit [.]

#### **I048/070/MODE3A - Mode-3/A Reply in Octal Representation**

- 12 bits [.....]
- Octal string (3-bits per digit)

Notes:

1. Bit 15 has no meaning in the case of a smoothed Mode-3/A code and is set to 0 for a calculated track. For Mode S, it is set to one when an error correction has been attempted.
2. For Mode S, bit 16 is normally set to zero, but can exceptionally be set to one to indicate a non-validated Mode-3/A code (e.g. alert condition detected, but new Mode-3/A code not successfully extracted).

## **I048/080 - Mode-3/A Code Confidence Indicator**

*Definition:* Confidence level for each bit of a Mode-3/A reply as provided by a monopulse SSR station.

*Structure:*

### **I048/080/(spare)**

- 4 bits [ . . . . ]

### **I048/080/QA4**

- 1 bit [ . ]
- values:
  - 0: High quality pulse A4
  - 1: Low quality pulse A4

### **I048/080/QA2**

- 1 bit [ . ]
- values:
  - 0: High quality pulse A2
  - 1: Low quality pulse A2

### **I048/080/QA1**

- 1 bit [ . ]
- values:
  - 0: High quality pulse A1
  - 1: Low quality pulse A1

### **I048/080/QB4**

- 1 bit [ . ]
- values:
  - 0: High quality pulse B4
  - 1: Low quality pulse B4

### **I048/080/QB2**

- 1 bit [ . ]
- values:
  - 0: High quality pulse B2
  - 1: Low quality pulse B2

### **I048/080/QB1**

- 1 bit [ . ]
- values:
  - 0: High quality pulse B1
  - 1: Low quality pulse B1

### **I048/080/QC4**

- 1 bit [ . ]
- values:
  - 0: High quality pulse C4
  - 1: Low quality pulse C4

#### **I048/080/QC2**

- 1 bit [.]
- values:
  - 0: High quality pulse C2
  - 1: Low quality pulse C2

#### **I048/080/QC1**

- 1 bit [.]
- values:
  - 0: High quality pulse C1
  - 1: Low quality pulse C1

#### **I048/080/QD4**

- 1 bit [.]
- values:
  - 0: High quality pulse D4
  - 1: Low quality pulse D4

#### **I048/080/QD2**

- 1 bit [.]
- values:
  - 0: High quality pulse D2
  - 1: Low quality pulse D2

#### **I048/080/QD1**

- 1 bit [.]
- values:
  - 0: High quality pulse D1
  - 1: Low quality pulse D1

### **I048/090 - Flight Level in Binary Representation**

*Definition:* Flight Level converted into binary representation.

*Structure:*

#### **I048/090/V**

- 1 bit [.]
- values:
  - 0: Code validated
  - 1: Code not validated

#### **I048/090/G**

- 1 bit [.]
- values:
  - 0: Default
  - 1: Garbled code

#### **I048/090/FL**

- 14 bits [.....]

- unsigned quantity
- scaling factor: 1
- fractional bits: 2
- unit: "FL"
- $\text{LSB} = 1/2^2 \text{ FL} = 1/4 \text{ FL} \approx 0.25 \text{ FL}$

Notes:

1. When Mode C code / Mode S altitude code is present but not decodable, the "Undecodable Mode C code / Mode S altitude code" Warning/Error should be sent in I048/030.
2. When local tracking is applied and the received Mode C code / Mode S altitude 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 I048/030.
3. The value shall be within the range described by ICAO Annex 10
4. For Mode S, bit 15 (G) is set to one when an error correction has been attempted.

## **I048/100 - Mode-C Code and Code Confidence Indicator**

*Definition:* Mode-C height in Gray notation as received from the transponder together with the confidence level for each reply bit as provided by a MSSR/Mode S station.

*Structure:*

### **I048/100/V**

- 1 bit [.]
- values:
  - 0: Code validated
  - 1: Code not validated

### **I048/100/G**

- 1 bit [.]
- values:
  - 0: Default
  - 1: Garbled code

### **I048/100/(spare)**

- 2 bits [..]

### **I048/100/MODEC - Mode-C Reply in Gray Notation**

- 12 bits [.....]
- raw value

### **I048/100/(spare)**

- 4 bits [....]

### **I048/100/QC1**

- 1 bit [.]
- values:
  - 0: High quality pulse C1
  - 1: Low quality pulse C1

### **I048/100/QA1**

- 1 bit [.]
- values:
  - 0: High quality pulse A1
  - 1: Low quality pulse A1

#### **I048/100/QC2**

- 1 bit [.]
- values:
  - 0: High quality pulse C2
  - 1: Low quality pulse C2

#### **I048/100/QA2**

- 1 bit [.]
- values:
  - 0: High quality pulse A2
  - 1: Low quality pulse A2

#### **I048/100/QC4**

- 1 bit [.]
- values:
  - 0: High quality pulse C4
  - 1: Low quality pulse C4

#### **I048/100/QA4**

- 1 bit [.]
- values:
  - 0: High quality pulse A4
  - 1: Low quality pulse A4

#### **I048/100/QB1**

- 1 bit [.]
- values:
  - 0: High quality pulse B1
  - 1: Low quality pulse B1

#### **I048/100/QD1**

- 1 bit [.]
- values:
  - 0: High quality pulse D1
  - 1: Low quality pulse D1

#### **I048/100/QB2**

- 1 bit [.]
- values:
  - 0: High quality pulse B2
  - 1: Low quality pulse B2

#### **I048/100/QD2**

- 1 bit [.]
- values:

- 0: High quality pulse D2
- 1: Low quality pulse D2

#### **I048/100/QB4**

- 1 bit [.]
- values:
  - 0: High quality pulse B4
  - 1: Low quality pulse B4

#### **I048/100/QD4**

- 1 bit [.]
- values:
  - 0: High quality pulse D4
  - 1: Low quality pulse D4

Notes:

1. For Mode S, D1 is also designated as Q, and is used to denote either 25ft or 100ft reporting.
2. For Mode S, bit-31 (G) is set when an error correction has been attempted.

### **I048/110 - Height Measured by a 3D Radar**

*Definition:* Height of a target as measured by a 3D radar. The height shall use mean sea level as the zero reference level.

*Structure:*

#### **I048/110/(spare)**

- 2 bits [..]

**I048/110/3DH** - 3D Height, in Binary Notation. Negative Values Are Expressed in Two's Complement

- 14 bits [.....]
- signed quantity
- scaling factor: 25
- fractional bits: 0
- unit: "ft"
- LSB = 25 ft

### **I048/120 - Radial Doppler Speed**

*Definition:* Information on the Doppler Speed of the target report.

*Structure:*

Compound item (FX)

#### **I048/120/CAL** - Calculated Doppler Speed

##### **I048/120/CAL/D**

- 1 bit [.]
- values:
  - 0: Doppler speed is valid
  - 1: Doppler speed is doubtful



**I048/120/CAL/(spare)**

- 5 bits [ . . . . . ]

**I048/120/CAL/CAL** - *Calculated Doppler Speed, Coded in Two's Complement*

- 10 bits [ . . . . . ]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: "m/s"
- LSB = 1 m/s

**I048/120/RDS** - *Raw Doppler Speed*

Repetitive item, repetition factor 8 bits.

**I048/120/RDS/DOP** - *Doppler Speed*

- 16 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: "m/s"
- LSB = 1 m/s

**I048/120/RDS/AMB** - *Ambiguity Range*

- 16 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: "m/s"
- LSB = 1 m/s

**I048/120/RDS/FRQ** - *Transmitter Frequency*

- 16 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 0
- unit: "MHz"
- LSB = 1 MHz

Notes:

- Although the meaning of a positive or negative value is implementation dependent and shall be described in the ICD of the system generating the ASTERIX record, it is recommended to transmit a positive value for targets moving away from the radar.

**I048/130 - Radar Plot Characteristics**

*Definition:* Additional information on the quality of the target report.

*Structure:*

Compound item (FX)

**I048/130/SRL** - *SSR Plot Runlength*

SSR plot runlength, expressed as a positive binary value.

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 360
- fractional bits: 13

- unit: "°"
- $\text{LSB} = 360/2^{13} \text{ }^\circ = 360/8192 \text{ }^\circ \approx 4.39453125e - 2 \text{ }^\circ$

**I048/130/SRR** - *Number of Received Replies for (M)SSR*

Number of Received Replies for (M)SSR

- 8 bits [ . . . . . ]
- unsigned integer

**I048/130/SAM** - *Amplitude of (M)SSR Reply*

Amplitude of (M)SSR Reply

- 8 bits [ . . . . . ]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: "dBm"
- $\text{LSB} = 1 \text{ dBm}$

**I048/130/PRL** - *Primary Plot Runlength*

Primary Plot Runlength, expressed as positive binary value

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 360
- fractional bits: 13
- unit: "°"
- $\text{LSB} = 360/2^{13} \text{ }^\circ = 360/8192 \text{ }^\circ \approx 4.39453125e - 2 \text{ }^\circ$

**I048/130/PAM** - *Amplitude of Primary Plot*

Amplitude of Primary Plot

- 8 bits [ . . . . . ]
- signed quantity
- scaling factor: 1
- fractional bits: 0
- unit: "dBm"
- $\text{LSB} = 1 \text{ dBm}$

**I048/130/RPD** - *Difference in Range Between PSR and SSR Plot*

Range (PSR-SSR)

- 8 bits [ . . . . . ]
- signed quantity
- scaling factor: 1
- fractional bits: 8
- unit: "NM"
- $\text{LSB} = 1/2^8 \text{ NM} = 1/256 \text{ NM} \approx 3.90625e - 3 \text{ NM}$

**I048/130/APD** - *Difference in Azimuth Between PSR and SSR Plot*

Azimuth (PSR-SSR)

- 8 bits [ . . . . . ]
- signed quantity
- scaling factor: 360
- fractional bits: 14
- unit: "°"
- $\text{LSB} = 360/2^{14} \text{ }^\circ = 360/16384 \text{ }^\circ \approx 2.197265625e - 2 \text{ }^\circ$

Notes:

1. The total range covered is therefore from 0 to 11.21 °.
2. Negative values are coded in two's complement form.
3. The total range covered is therefore from 0 to 11.21 °.
4. Negative values are coded in two's complement form.
5. Negative values are coded in two's complement form.
6. The covered range difference is +/- 0.5 NM.
7. Sending the maximum value means that the difference in range is equal or greater than the maximum value.
8. Negative values are coded in two's complement form.
9. The covered azimuth difference is  $\pm 360/2^7 = \pm 2.8125^\circ$ .
10. Sending the maximum value means that the difference in range is equal or greater than the maximum value.

### **I048/140 - Time of Day**

*Definition:* Absolute time stamping expressed as Co-ordinated Universal Time (UTC).

*Structure:*

- 24 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 7
- unit: "s"
- $\text{LSB} = 1/2^7 \text{ s} = 1/128 \text{ s} \approx 7.8125e-3 \text{ s}$
- value  $< 86400 \text{ s}$

Notes:

1. The time of day value is reset to 0 each day at midnight.
2. Every radar station using ASTERIX should be equipped with at least one synchronised time source

### **I048/161 - Track Number**

*Definition:* An integer value representing a unique reference to a track record within a particular track file.

*Structure:*

#### **I048/161/(spare)**

- 4 bits [ . . . . ]

#### **I048/161/TRN - Track Number**

- 12 bits [ . . . . . ]
- raw value

### **I048/170 - Track Status**

*Definition:* Status of monoradar track (PSR and/or SSR updated).

*Structure:*

Extended item.

#### **I048/170/CNF - Confirmed Vs. Tentative Track**

- 1 bit [.]
- values:
  - 0: Confirmed Track
  - 1: Tentative Track

**I048/170/RAD** - *Type of Sensor(s) Maintaining Track*

- 2 bits [..]
- values:
  - 0: Combined Track
  - 1: PSR Track
  - 2: SSR/Mode S Track
  - 3: Invalid

**I048/170/DOU** - *Signals Level of Confidence in Plot to Track Association Process*

- 1 bit [.]
- values:
  - 0: Normal confidence
  - 1: Low confidence in plot to track association

**I048/170/MAH** - *Manoeuvre Detection in Horizontal Sense*

- 1 bit [.]
- values:
  - 0: No horizontal man.sensed
  - 1: Horizontal man. sensed

**I048/170/CDM** - *Climbing / Descending Mode*

- 2 bits [..]
- values:
  - 0: Maintaining
  - 1: Climbing
  - 2: Descending
  - 3: Unknown

(FX)

- extension bit
  - 0: End of data item
  - 1: Extension into next extent

**I048/170/TRE** - *Signal for End\_of\_Track*

- 1 bit [.]
- values:
  - 0: Track still alive
  - 1: End of track lifetime(last report for this track)

**I048/170/GHO** - *Ghost Vs. True Target*

- 1 bit [.]
- values:
  - 0: True target track
  - 1: Ghost target track

**I048/170/SUP** - *Track Maintained with Track Information from Neighbouring Node B on the Cluster, or Network*

- 1 bit [.]
- values:
  - 0: No
  - 1: Yes

**I048/170/TCC** - *Type of Plot Coordinate Transformation Mechanism:*

- 1 bit [.]
- values:
  - 0: Tracking performed in so-called 'Radar Plane', i.e. neither slant range correction nor stereographical projection was applied
  - 1: Slant range correction and a suitable projection technique are used to track in a 2D.reference plane, tangential to the earth model at the Radar Site co-ordinates

**I048/170/(spare)**

- 3 bits [.]
- (FX)
- extension bit
    - 0: End of data item
    - 1: Extension into next extent

**I048/200 - Calculated Track Velocity in Polar Co-ordinates**

*Definition:* Calculated track velocity expressed in polar co-ordinates.

*Structure:*

**I048/200/GSP** - *Calculated Groundspeed*

- 16 bits [.....]
- unsigned quantity
- scaling factor: 1
- fractional bits: 14
- unit: "NM/s"
- $LSB = 1/2^{14} \text{ NM/s} = 1/16384 \text{ NM/s} \approx 6.103515625e - 5 \text{ NM/s}$

**I048/200/HDG** - *Calculated Heading*

- 16 bits [.....]
- unsigned quantity
- scaling factor: 360
- fractional bits: 16
- unit: "°"
- $LSB = 360/2^{16} \text{ °} = 360/65536 \text{ °} \approx 5.4931640625e - 3 \text{ °}$

Notes:

- The calculated heading is related to the geographical North at the aircraft position.

## **I048/210 - Track Quality**

*Definition:* Track quality in the form of a vector of standard deviations.

*Structure:*

**I048/210/SIGX** - *Sigma (X)) Standard Deviation on the Horizontal Axis of the Local Grid System*

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 7
- unit: "NM"
- $LSB = 1/2^7 \text{ NM} = 1/128 \text{ NM} \approx 7.8125e - 3 \text{ NM}$

**I048/210/SIGY** - *Sigma (Y)) Standard Deviation on the Vertical Axis of the Local Grid System*

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 7
- unit: "NM"
- $LSB = 1/2^7 \text{ NM} = 1/128 \text{ NM} \approx 7.8125e - 3 \text{ NM}$

**I048/210/SIGV** - *Sigma (V)) Standard Deviation on the Groundspeed Within the Local Grid System*

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 1
- fractional bits: 14
- unit: "NM/s"
- $LSB = 1/2^{14} \text{ NM/s} = 1/16384 \text{ NM/s} \approx 6.103515625e - 5 \text{ NM/s}$

**I048/210/SIGH** - *Sigma (H)) Standard Deviation on the Heading Within the Local Grid System*

- 8 bits [ . . . . . ]
- unsigned quantity
- scaling factor: 360
- fractional bits: 12
- unit: "°"
- $LSB = 360/2^{12} \text{ °} = 360/4096 \text{ °} \approx 8.7890625e - 2 \text{ °}$

Notes:

1. The standard deviation is per definition a positive value, hence the range covered is :  $0 \leq \text{Sigma}(X) < 2 \text{ NM}$
2. The standard deviation is per definition a positive value, hence the range covered is :  $0 \leq \text{Sigma}(Y) < 2 \text{ NM}$
3. The standard deviation is per definition a positive value, hence the range covered is:  $0 \leq \text{Sigma}(V) < 56.25 \text{ Kt}$
4. The standard deviation is per definition a positive value; hence the range covered is:  $0 \leq \text{sigma}(H) < 22.5 \text{ degrees}$ .

## **I048/220 - Aircraft Address**

*Definition:* Aircraft address (24-bits Mode S address) assigned uniquely to each aircraft.

*Structure:*

- 24 bits [ . . . . . ]
- raw value

### **Note:**

- The Encoding Rule for Data Item I048/220 has been relaxed in Edition 1.30 for the “End of Track Message”. In order to prevent interoperability problems it is recommended that systems sending I048/220 in an “End of Track Message” continue to do so.

## **I048/230 - Communications/ACAS Capability and Flight Status**

*Definition:* Communications capability of the transponder, capability of the on-board ACAS equipment and flight status.

*Structure:*

### **I048/230/COM** - *Communications Capability of the Transponder*

- 3 bits [ . . . ]
- values:
  - 0: No communications capability (surveillance only)
  - 1: Comm. A and Comm. B capability
  - 2: Comm. A, Comm. B and Uplink ELM
  - 3: Comm. A, Comm. B, Uplink ELM and Downlink ELM
  - 4: Level 5 Transponder capability

### **I048/230/STAT** - *Flight Status*

- 3 bits [ . . . ]
- values:
  - 0: No alert, no SPI, aircraft airborne
  - 1: No alert, no SPI, aircraft on ground
  - 2: Alert, no SPI, aircraft airborne
  - 3: Alert, no SPI, aircraft on ground
  - 4: Alert, SPI, aircraft airborne or on ground
  - 5: No alert, SPI, aircraft airborne or on ground
  - 7: Unknown

### **I048/230/SI** - *SI/II Transponder Capability*

- 1 bit [ . ]
- values:
  - 0: SI-Code Capable
  - 1: II-Code Capable

### **I048/230/(spare)**

- 1 bit [ . ]

### **I048/230/MSSC** - *Mode-S Specific Service Capability*

- 1 bit [ . ]
- values:

0: No  
1: Yes

#### **I048/230/ARC** - *Altitude Reporting Capability*

- 1 bit [.]
- values:
  - 0: 100 ft resolution
  - 1: 25 ft resolution

#### **I048/230/AIC** - *Aircraft Identification Capability*

- 1 bit [.]
- values:
  - 0: No
  - 1: Yes

#### **I048/230/B1A** - *BDS 1,0 Bit 16*

- 1 bit [.]
- raw value

#### **I048/230/B1B** - *BDS 1,0 Bits 37/40*

- 4 bits [....]
- raw value

#### **Note:**

- This item shall be present in every ASTERIX record conveying data related to a Mode S target, except for an “End of Track Message” (i.e. I048/170, First Extension, Bit 8 is set to “1”) in which this Data Item is optional. If the datalink capability has not been extracted yet, bits 16/14 shall be set to zero.

#### **I048/240 - Aircraft Identification**

*Definition:* Aircraft identification (in 8 characters) obtained from an aircraft equipped with a Mode S transponder.

*Structure:*

- 48 bits [... 48 bits ...]
- ICAO string (6-bits per character)

*Notes:*

1. This data item contains the flight identification as available in the respective Mode S transponder registers.
2. The Encoding Rule for Data Item I048/240 has been relaxed in Edition 1.30 for the “End of Track Message”. In order to prevent interoperability problems it is recommended that systems sending I048/240 in an “End of Track Message” continue to do so.



## **I048/250 - BDS Register Data**

*Definition:* BDS Register Data as extracted from the aircraft transponder.

*Structure:*

Repetitive item, repetition factor 8 bits.

### **I048/250/MBDATA** - Mode S Comm B Message Data

- 56 bits [... 56 bits ...]
- raw value

### **I048/250/BDS1** - Comm B Data Buffer Store 1 Address

- 4 bits [...]
- raw value

### **I048/250/BDS2** - Comm B Data Buffer Store 2 Address

- 4 bits [...]
- raw value

Notes:

1. For the transmission of BDS Register 2,0, Data Item I048/240 is used.
2. For the transmission of BDS Register 3,0, Data Item I048/260 is used. In case of ACAS Xu (as defined in [3]), the Resolution Advisory consists of two parts (BDS Register 3,0 and BDS Register 3,1). BDS Register 3,1 will be transmitted using Data Item I048/250. For the detailed definition of BDS Register 3,0 and 3,1 please refer to [2] Tables B-3-48a and B-3-49.
3. In case of data extracted via Comm-B broadcast, all bits of fields BDS1 and BDS2 are set to 0; in case of data extracted via GICB requests, the fields BDS1 and BDS2 correspond to the GICB register number.
4. The Encoding Rule for Data Item I048/250 has been relaxed in Edition 1.30 for the "End of Track Message". In order to prevent interoperability problems it is recommended that systems sending I048/250 in an "End of Track Message" continue to do so.

## **I048/260 - ACAS Resolution Advisory Report**

*Definition:* Currently active Resolution Advisory (RA), if any, generated by the ACAS associated with the transponder transmitting the report and threat identity data.

*Structure:*

- 56 bits [... 56 bits ...]
- raw value

Notes:

1. Refer to ICAO Draft SARPs for ACAS for detailed explanations.
2. In case of ACAS Xu, the Resolution Advisory consists of two parts (BDS30 and BDS31). BDS31 will be transmitted using item 250.

## **I048/RE - Reserved Expansion Field**

*Definition:* Expansion

*Structure:*

Explicit item (RE)

## **I048/SP - Special Purpose Field**

*Definition:* Special Purpose Field

*Structure:*

Explicit item (SP)

## **User Application Profile for Category 048**

- (1) I048/010 - Data Source Identifier
- (2) I048/140 - Time of Day
- (3) I048/020 - Target Report Descriptor
- (4) I048/040 - Measured Position in Polar Co-ordinates
- (5) I048/070 - Mode-3/A Code in Octal Representation
- (6) I048/090 - Flight Level in Binary Representation
- (7) I048/130 - Radar Plot Characteristics
- (FX) - Field extension indicator
- (8) I048/220 - Aircraft Address
- (9) I048/240 - Aircraft Identification
- (10) I048/250 - BDS Register Data
- (11) I048/161 - Track Number
- (12) I048/042 - Calculated Position in Cartesian Co-ordinates
- (13) I048/200 - Calculated Track Velocity in Polar Co-ordinates
- (14) I048/170 - Track Status
- (FX) - Field extension indicator
- (15) I048/210 - Track Quality
- (16) I048/030 - Warning/Error Conditions and Target Classification
- (17) I048/080 - Mode-3/A Code Confidence Indicator
- (18) I048/100 - Mode-C Code and Code Confidence Indicator
- (19) I048/110 - Height Measured by a 3D Radar
- (20) I048/120 - Radial Doppler Speed
- (21) I048/230 - Communications/ACAS Capability and Flight Status
- (FX) - Field extension indicator
- (22) I048/260 - ACAS Resolution Advisory Report
- (23) I048/055 - Mode-1 Code in Octal Representation
- (24) I048/050 - Mode-2 Code in Octal Representation
- (25) I048/065 - Mode-1 Code Confidence Indicator
- (26) I048/060 - Mode-2 Code Confidence Indicator
- (27) I048/SP - Special Purpose Field
- (28) I048/RE - Reserved Expansion Field
- (FX) - Field extension indicator