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Abstract:

This document contains a detailed description of the Extended Polar Image data format DF-047.

The format may be used for storing of digitized radar images together with additional system and statistics information.

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1	Original issue.
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1 INTRODUCTION

This document describes the Miros Extended Polar Image Data Format DF-047.

The format may be used for storing of digitized radar images together with additional system and statistics information. It is divided into one header section and five data sections.

DF-047 is a binary data format.

2 DATA FORMAT DESCRIPTION

2.1 General Description

Section	Description	Note
1	Header Section	See chapter 2.2.
2	System Data Section	See chapter 2.3.
3	Statistics Data Section	See chapter 2.4.
4	Auxiliary Data Section	See chapter 2.5.
5	Register Data Section	See chapter 2.6.
6	Image Data Section	See chapter 2.7.

The Header Section is fixed in size and contains information about the data format version and size of each of the five data sections.

The System Data section is flexible in size and contains data set date, time and time zone in addition to general system information.

The Statistics Data section is flexible in size and contains statistics parameters.

The Auxiliary Data section is flexible in size and may contain any type or types of site or system specific data.

The Register Data section is flexible in size and contains data received from a Miros Wavex system card or box.

The Image Data section is flexible in size and contains a two dimensional matrix trailing the matrix orientation, dimension and parameter resolution information, matrix element size and matrix total size.

2.2 Header Section Description

The fixed size Header Section contains data as shown in the below table.

Element Number	Description	Format	Number Of Bytes
1	Format Name and Version	'DF-047-nnn'	10
2	System Data Section Size	Unsigned Integer	4
3	Statistics Data Section Size	Unsigned Integer	4
4	Auxiliary Data Section Size	Unsigned Integer	4
5	Register Data Section Size	Unsigned Integer	4
6	Image Data Section Size	Unsigned Integer	4

The Header Section elements are:

Element 1: Data format name and version as *'DF-047-nnn'* where *'nnn'* is a three digit integer number starting at 001.

Element 2: Total size in bytes of the System Data section.

Element 3: Total size in bytes of the Statistics Data section.

Element 4: Total size in bytes of the Auxiliary Data section.

Element 5: Total size in bytes of the Register Data section.

Element 6: Total size in bytes of the Image Data section.

2.3 System Data Section Description

The System Data section is the first of the five data sections and contains data as described in the below table.

Element Number	Description	Format	Number Of Bytes
1	Date and Time	'yyyy-mm-dd hh:nn:ss'	19
2	Time Zone	Byte	1
3	Vessel Speed	Float	4
4	Vessel Heading	Float	4
5	Vessel Track	Float	4
6	Position Longitude	Float	4
7	Position Latitude	Float	4
8	Wind Speed 2 Min Mean	Float	4
9	Wind Direction 2 Min Mean	Float	4
10	Wind Speed 10 Min Mean	Float	4
11	Wind Direction 10 Min Mean	Float	4
12	Current Speed	Float	4
13	Current Direction	Float	4
14	Show Oil	Unsigned Integer	4
15	Image Gray Scale Levels	Unsigned Integer	4

The System Data section elements are:

Element 1: Date and Time representing the entire data set. The format is 24 hours as *'yyyy-mm-dd hh:nn:ss'* where *'yyyy'* is year (four digits), *'mm'* is month (01 to 12), *'dd'* is day (01 to 31), *'hh'* is hours (00 to 23), *'nn'* is minutes (00 to 59) and *'ss'* is seconds (00 to 59).

Element 2: A code for the time zone representing the date and time when the data set was collected. See Appendix A for time zone code details. If time zone information is not used a "-" character (hyphen) shall replace the time zone character.

Element 3: Instantaneous Vessel Speed in metres pr. second. If data is not available an undefined value is indicated by *'-999.99'*.

Element 4: Instantaneous Vessel Heading in degrees True (0 to 360 degrees clockwise). 0 (zero) degrees indicates an error state and is not a valid direction. If data is not available an undefined value is indicated by *'-999.99'*.

Element 5: Instantaneous Vessel Track in degrees True (0 to 360 degrees clockwise). 0 (zero) degrees indicates an error state and is not a

valid direction. If data is not available an undefined value is indicated by *'-999.99'*.

Element 6: Instantaneous Vessel Position Longitude as *'dmm.t'* where *'d'* is degrees (-180 to 180), *'mm'* is minutes (00 to 59) and *'t'* is decimal-fraction of minutes in a variable number of digits. A positive value means an Eastern longitude, a negative value means a Western longitude. Maximum value is 18000.0, minimum value is -18000.0. If data is not available an undefined value is indicated by *'-999.99'*.

Element 7: Instantaneous Vessel Position Latitude as *'dmm.t'* where *'d'* is degrees (-90 to 90), *'mm'* is minutes (00 to 59) and *'t'* is decimal-fraction of minutes in a variable number of digits. A positive value means a Northern latitude, a negative value means a Southern latitude. Maximum value is 9000.0, minimum value is -9000.0. If data is not available an undefined value is indicated by *'-999.99'*.

Element 8: Wind Speed 2 minutes mean in metres pr. second. If data is not available an undefined value is indicated by *'-999.99'*.

Element 9: Wind Direction 2 minutes mean in degrees True (0 to 360 degrees clockwise). 0 (zero) degrees indicates an error state and is not a valid direction. If data is not available an undefined value is indicated by *'-999.99'*.

Element 10: Wind Speed 10 minutes mean in metres pr. second. If data is not available an undefined value is indicated by *'-999.99'*.

Element 11: Wind Direction 10 minutes mean in degrees True (0 to 360 degrees clockwise). 0 (zero) degrees indicates an error state and is not a valid direction. If data is not available an undefined value is indicated by *'-999.99'*.

Element 12: Average Current Speed in metres pr. second. If data is not available an undefined value is indicated by *'-999.99'*.

Element 13: Average Current Direction in degrees True (0 to 360 degrees clockwise). 0 (zero) degrees indicates an error state and is not a valid direction. If data is not available an undefined value is indicated by *'-999.99'*.

Element 14: When the DF-047 format is used in an Oil Spill Detection system, this indicator can be used to decide whether to raise an oil spill detection alarm or not. *'0'* means *'false'* or *'not in use'*, *'1'* means *'true'*.

Element 15: Number of gray scale levels in the Image Data Matrix. The lowest legal number of levels is 3, in which the Image Data Matrix will contain zeros, ones and twos. In an Oil Spill Detection system the zeros represent undefined zones, the ones represent water and the twos represent detected oil. If number of gray scale levels is higher than 3 it means that the detected oil is grouped into several layers.
Set to 0 (zero) if not used.

2.4 Statistics Data Section Description

The Statistics Data section is the second of the data sections and follows immediately after the System Data section

Element Number	Description	Format	Number Of Bytes
1	Number Of Statistics Values	Unsigned Integer	4
2	Statistics Value 1	Float	4
3	Statistics Value 2	Float	4
:	:	:	
:	:	:	
n	Statistics Value n - 1	Float	4

The Statistics Data section elements are:

Element 1: Number of 32-bit float values to follow.

Element 2: Statistics value number 1.

Element 3: Statistics value number 2.

Element n: Statistics value number *'n - 1'* as the last Statistics section value. Element 1 holds the value of *'n - 1'*.

Wavex version 4 uses four fixed statistics values. These are:

Element 2: Relative signal for the Cartesian section number 1, image set number 1. If data is not available an undefined value is indicated by *'-999.99'*.

Element 3: Relative signal for the Cartesian section number 2, image set number 1. If data is not available an undefined value is indicated by *'-999.99'*.

Element 4: Relative signal for the Cartesian section number 1, image set number 2. If data is not available an undefined value is indicated by *'-999.99'*.

Element 5: Relative signal for the Cartesian section number 2, image set number 2. If data is not available an undefined value is indicated by *'-999.99'*.

2.5 Auxiliary Data Section Description

The Auxiliary Data section is the third of the data sections and follows immediately after the Statistics Data section. This section is open in the way that it may contain any type or types of site or system specific data. The Auxiliary Data section may also be empty.

2.6 Register Data Section Description

The Register Data section is the fourth of the data sections and follows immediately after the Auxiliary Data section. It contains data gathered from a Miros Wavex system card or box as described in the below table.

Element Number	Description	Format	Number Of Bytes
1	Number Of Register Values	Unsigned Integer	4
2	Register Value 1	Unsigned Integer	4
3	Register Value 2	Unsigned Integer	4
:	:	:	
:	:	:	
n	Register Value n - 1	Unsigned Integer	4

The Register Data section elements are:

Element 1: Number of 32-bit unsigned integer values to follow.

Element 2: Register value number 1.

Element 3: Register value number 2.

Element n: Register value number *'n - 1'* as the last Register section value. Element 1 holds the value of *'n - 1'*.

See Appendix B for a complete Register Data section content.

2.7 Image Data Section Description

The Image Data section follows immediately after the Register Data section and is the last of the five data sections. It contains data as described in the below table.

Element Number	Description	Format	Number Of Bytes
1	Polar Image Orientation	Byte	1
2	No. of X-dimension Elements	Unsigned Integer	4
3	X-dimension Start Value	Float	4
4	X-dimension Resolution	Float	4
5	No. of Y-dimension Elements	Unsigned Integer	4
6	Y-dimension Start Value	Float	4
7	Y-dimension Resolution	Float	4
8	Image Data Element Size	Unsigned Integer	4
9	Image Data Entire Size	Unsigned Integer	4
10 - n	Image Data Content	Unsigned Integer Matrix	Element 9

The Image Data section elements are:

Element 1: Polar Image orientation *'T'* or *'R'*. A value of *'T'* means Relative to True North, a value of *'R'* means Relative to Vessel Heading.

Element 2: Number of elements in the Image Data matrix X-dimension. The X-dimension represents Radar Range.

Element 3: Start value for the Image Data matrix X-dimension in metres.

Element 4: Resolution of the Image Data matrix X-dimension in metres.

Element 5: Number of elements in the Image Data matrix Y-dimension. The Y-dimension represents Radar Azimuth.

Element 6: Start value for the Image Data matrix Y-dimension in degrees.

Element 7: Resolution of the Image Data matrix Y-dimension in degrees.

Element 8: Size in bytes for each integer element in the Image Data matrix.

Element 9: Size in bytes of the entire Image Data matrix.

Element 10 - n: The Image Data matrix itself, represented as [x1, y1], [x2, y1], [x3, y1]...[x1, y2], [x2, y2], [x3, y2]...

3 FILE NAME CONVENTION

3.1 DF-047 NOW Files

Miros standard file name convention for DF-047 NOW files is:

```
SSS_XXXnnn_NOW.DF047
```

where
- SSS = Site Identifier (three alpha-numeric characters).
- XXX = Sequence Number (up to eight alpha-numeric characters).
- nnn = A three digit number starting at 001.
- DF047 = File Extension.

Examples:
```
MIR_POL001_NOW.DF047
MIR_POL002_NOW.DF047
MIR_POL032_NOW.DF047
```

3.2 DF-047 History Files

Miros standard file name convention for DF-047 History files is:

```
SSS_YYYYMMDD_HHNNSS_XXXnnn.DF047
```

where in addition to the above codes:
- YYYY = Year (four digits).
- MM = Month (two digits with a leading zero if required).
- DD = Day (two digits with a leading zero if required).
- HH = Hours (two digits in 24 hours format with a leading zero if required).
- NN = Minutes (two digits with a leading zero if required).
- SS = Seconds (two digits with a leading zero if required).

Examples:
```
SSS_20040118_153000_POL001.DF047
SSS_20040118_153000_POL002.DF047
SSS_20040118_153000_POL032.DF047
```

4 APPENDIX A - Standard (Winter) Time Zones

Relative GMT	Code	Phonetic	Civilian Time Zones
0:00	Z	Zulu	Greenwich Mean, Universal (Co-ordinated), Western European
+1:00	A	Alpha	Central European, Middle European Winter
+2:00	B	Bravo	Eastern European, USSR Zone 1
+3:00	C	Charlie	Baghdad, USSR Zone 2
+4:00	D	Delta	USSR Zone 3
+5:00	E	Echo	USSR Zone 4
+6:00	F	Foxtrot	USSR Zone 5
+7:00	G	Golf	West Australian Standard
+8:00	H	Hotel	China Coast, USSR Zone 7
+9:00	J	Juliet	Japan Standard, USSR Zone 8
+10:00	K	Kilo	East Australian Standard, Guam Standard, USSR Zone 9
+11:00	L	Lima	
+12:00	M	Mike	International Date Line East, New Zealand
-1:00	N	November	West Africa
-2:00	O	Oscar	Azores
-3:00	P	Papa	Mid. Greenland, Argentina, East Brazil
-4:00	Q	Quebec	Atlantic Standard
-5:00	R	Romeo	Eastern Standard
-6:00	S	Sierra	Central Standard
-7:00	T	Tango	Mountain Standard
-8:00	U	Uniform	Pacific Standard
-9:00	V	Victor	Yukon Standard
-10:00	W	Whiskey	Alaska-Hawaii Standard, Central Alaska, Hawaii Standard
-11:00	X	X-ray	Nome
-12:00	Y	Yankee	International Date Line West

5 APPENDIX B - Register Data Content

The below table is a description of the Register Data content with its 21 16-bit integers and the values that each parameter can have.

Some integers hold more than one Register parameter, and in one case two integers are used in combination to form one Register parameter.

The table's 1st column lists the Register's integer number, and the 2nd column the bit or bits used to get the specific Register parameter described in the 3rd column. The 4th column shows the valid values that each Register parameter can have. The actual meaning of a parameter value is written in parenthesis behind the value.

For further details please refer to Miros document TN/003/97/TE/1300/D; *WAVEX40/80 - REGISTER DESCRIPTION*.

Integer	Bits	Description	Valid Values
0	0 - 7	Card Id	87 (ASCII 'W' for Wavex)
0	8 - 15	Configuration	83 (ASCII 'S' for Single A/D) or 68 (ASCII 'D' for Double A/D)
1	0 - 2	Sampling Rate	0 (20 MHz), 1 (32 MHz), 2 (40 MHz), 3 (64 MHz) or 4 (80 MHz)
1	3	Not Used	Not Used
1	4	Video Sign	0 (Positive) or 1 (Negative)
1	5 - 7	Video Gain	0 (x1.0), 1 (x0.8), 2 (x0.6), 3 (x0.4), 4 (x0.2) or 5 (x0.1)
1	8 - 15	Video Offset	0 to 127 (0 to 0.625 volt) or 128 to 256 (-0.625 to 0 volt)
2	0 - 7	Range Delay	1 (0.2 µs = 30 m) to 255 (25.6 µs = 3840 m) in 0.1 µs step
2	8 - 15	Range Interval	1 (0.4 µs = 60 m) to 255 (102.0 µs = 15300 m)in 0.4 µs step
3	0 - 11	Azimuth Start Angle	1 (0.2°) to 4095 (409.6°)
3	12 - 15	Not Used	Not Used
4	0 - 11	Sector Size	1 (0.2°) to 4095 (409.6°)
4	12 - 15	Not Used	Not Used
5	0 - 5	Azimuth Step	1 (0.2°) to 63 (6.4°)
5	6 - 15	Not Used	Not Used
6	0 - 11	Number of images to collect	0 to 4095
6	12 - 15	Not Used	Not Used

Integer	Bits	Description	Valid Values
7	0 - 7	PRI Inhibit Time	0 (Off) or 1 (10 µs) to 255 (1280 µs)
7	8 - 15	RPI Inhibit Time	0 (Off) or 1 (0.02 s) to 255 (2.56 s)
8	0 - 7	Azimuth Inhibit Time	0 (Off) or 1 (0.4 ms) to 255 (51.2 ms)
8	8 - 15	Not Used	Not Used
9	0 - 3	Interrupt (IRQ)	2 to 7, 10 to 12, 14 or 15
9	4 - 15	Not Used	Not Used
10	0	Start or Stop Digitizing Images	0 (Stop) or 1 (Start)
10	1	Used for Angle Calculations	0 (RPI) or 1 (Azimuth)
10	2	Video Compression	0 (Off) or 1 (On)
10	3	Test Generator	0 (Off) or 1 (On)
10	4	Memory Bank Overflow	0 (OK) or 1 (Detected)
10	5	FIFO Full Flag	0 (OK) or 1 (Detected)
10	6	FIFO Empty Flag	0 (OK) or 1 (Detected)
10	7	Sync PRF Detect	0 (OK) or 1 (No pulse)
10	8	RPM Detect	0 (OK) or 1 (No pulse)
10	9	Azimuth Detect	0 (OK) or 1 (No pulse)
10	10	Radar Mode Change	0 (No) or 1 (Yes)
10	11	Not Used	Not Used
10	12	Not Used	Not Used
10	13 - 14	HW Version Number	0 to 3
10	15	Not Used	Not Used
11	0 - 15	Sync PRF	0 to 65535
12	0 - 15	PRI max	0 to 65535
13	0 - 15	RPI	900 (0.9 s) to 5100 (5.1 s)
14	0 - 15	Azimuth Count	0 to 65535
15	0 - 15	Sync Count	0 to 65535
16	0	Converter 1 Overflow	0 (OK) or 1 (Detected)
16	1	Converter 2 Overflow	0 (OK) or 1 (Detected)

Integer	Bits	Description	Valid Values
16	2	Not Used	Not Used
16	3	Not Used	Not Used
16	4	FIFO 1 Full Flag	0 (OK) or 1 (Detected)
16	5	FIFO 2 Full Flag	0 (OK) or 1 (Detected)
16	6	FIFO 3 Full Flag	0 (OK) or 1 (Detected)
	7	Not Used	Not Used
16	8	FIFO 1 Empty Flag	0 (OK) or 1 (Detected)
16	9	FIFO 2 Empty Flag	0 (OK) or 1 (Detected)
16	10	FIFO 3 Empty Flag	0 (OK) or 1 (Detected)
16	11	Not Used	Not Used
16	12	Memory Bank A Overflow	0 (OK) or 1 (Detected)
16	13	Memory Bank B Overflow	0 (OK) or 1 (Detected)
16	14	Not Used	Not Used
16	15	Not Used	Not Used
17	0 - 7	Snap Shot Prior To First Sample	0 to 255
17	8 - 15	Snap Shot After Last Sample	0 to 255
18	0 - 15	Image Counter	0 to 65535
19	0 - 15	Number Of Samples pr. Image, LSB	0 to 1048575
20	0 - 3	Number Of Samples pr. Image, MSB	
20	4 - 15	Not Used	Not Used

***