Operator Manual

EM Series

Datagram Formats

KONGSBERG
SIMRAD

EM Series

Multibeam echo sounder

Datagram formats

850-160692 / AA000 / 2-46

Note

Kongsberg Simrad AS makes every effort to ensure that the information contained within this document is correct. However, our equipment is continuously being improved and updated, so we cannot assume liability for any errors which may occur.

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to install, operate or maintain the equipment.

Kongsberg Simrad AS disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

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Remarks

References

Further information about the EM Series systems may be found in the following manuals:

- EM Series Installation manuals
- EM Series Operation manuals
- EM Series Maintenance manuals

The reader

This operator manual is intended to be used by the system operator. He/she should be experienced in the operation of positioning systems, or should have attended a Kongsberg Simrad training course.

Document revisions

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A	15.04.97	RBr	EHa	EHa
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(The original signatures are recorded in the company's logistic database)

Document history

(The information on this page is for internal use)

Rev.A Original issue.

Rev.B General update. Unnecessary information removed. Refer to EM 160692B.

Rev.C General update. Document 160793 (EM 300 Datagram formats) merged with this to create one common source of information for all multibeam echo sounders. Refer to EM 160692C.

Rev.D Remote Control, Raw Range And Beam Angle, Mechanical Transducer Tilt, Sound Speed Profile Input and Central Beams Echogram datagrams implemented. General update with multiple corrections to several input and output datagrams. Refer to EM 160692D.

Rev.E Layout changed for reading ease.

Several minor changes implemented throughout the document, mainly in the following chapters: 2.1. Introduction and 2.2. Position overview.

Minor corrections were implemented on the following datagrams: EA500 Format, Remote Control, Height (Remark), Sound Speed Profile and Runtime Parameter (Remarks) and Installation Parameters, AML Smart Sensor format, Kongsberg Simrad SSP output.

Rev.F Minor changes made to the following output datagrams: Depth (in Note 3), Raw range and beam angle (in Note 1), Surface sound speed output, Runtime parameters and Installation parameters. Also minor changes toi layout to allow for HTML distribution of the document. Refer to EM 160692F.

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1 INTRODUCTION

1.1 Purpose

The formats for data input and output to and from the EM Series multibeam echo sounders are described here. The information given here is valid for the Kongsberg Simrad multibeam echo sounders introduced after 1995.

Note ! *The information in this document is not valid for the EM 12, EM 100, EM 950 and EM 1000 multibeam echo sounders.*

Note ! *In order to meet special customer requirements, Kongsberg Simrad may have to change the datagram formats described here. The formats presented in this document may therefore be altered without prior notice, although backward compatibility will be maintained as far as possible. Before software is written in accordance with this document, it is strongly recommended to contact Kongsberg Simrad to ensure that the latest version is used, and that any planned changes are taken into account.*

1.2 Presentation format

The format description is according to the NMEA 0183 standard for ASCII fields, with the ASCII character(s) given as follows:

- "x.x" defines a variable length numerical field, with optionally included decimal point and sign.
- "c--c" defines a variable length field of printable characters.
- "x--x" defines a variable length field of numeric characters.
- "a__" defines a fixed length field of alphabetical characters (for example "aa"= two character long field.
- "x_ _" defines a fixed length field of numeric characters.

For binary fields, the length is given in number of bytes plus "U" for unsigned and "S" for signed data.

2 INPUT DATAGRAMS

2.1 Introduction

Only a limited number of input formats from external sensors are accepted. These are primarily in accordance with the NMEA 0183 specification, or based upon the principles of that specification.

Note ! *The majority of these formats have not been defined by Kongsberg Simrad. Thus, these formats are not controlled by Kongsberg Simrad.*

Almost all input formats are ASCII. Serial line input on the multibeam echo sounder's Processing Unit is most common, but some datagrams - which are not time critical - are interfaced on serial line(s) or Ethernet to the Operator Station.

2.2 Position

Overview

The EM Series accepts position data in the following formats:

- NMEA 0183 GGA
- GGK
- SIMRAD 90
- With the GGA and GGK datagrams, information contained in NMEA 0183 VGST and VTG datagrams will also be accepted and used.
- A datagram format for Sonar Head depth is provided for the EM 3000 and the EM 2000. Note that the format is the same as that used by the Paroscientific Digiquartz pressure sensor. This format may also be used for input of for example varying datum heights or other special height information on all models.
- A datagram format for input of tidal height is provided.

The **GGA format** is given below according to the NMEA 0183 version 2.30 description. Additional data at the end of the datagram is accepted to cater for users who need to log additional information than what is provided in the standard format. This is also supported with the GGK format. The total datagram length must be limited to less than 128 bytes if additional data is included.

Note ! *While such additional data will be logged, it is up to the user to extract the data to whatever use is required in postprocessing. Anyone using this possibility must also be aware that any future changes to the GGA or GGK format may require modifications in the datagrams and hence data decoding.*

The **GGK format** was originally defined by the US Army Corps of Engineers for their tests with kinematic GPS. Trimble's proprietary version of the format is supported. If any changes to the format are made if it becomes part of the NMEA standard, this will be implemented.

To preserve the inherent accuracy of the kinematic GPS data it is necessary to correct the data for vessel motion. This requires accurate timing synchronisation between the motion sensor and the GPS receiver. It is therefore imperative that:

- the position datagram has a constant and known time delay

or

- the time stamp in the datagram is actually the time of the position fix, that synchronisation to the 1 PPS signal of the GPS receiver is enabled, and that the system clock has been set correctly

As neither of these conditions may not be possible to achieve with a sufficient accuracy, the application of motion correction is operator selectable. Motion compensation may be applied to any position input, not only kinematic GPS.

In addition to position data from the GGA or GGK datagrams, speed and course over ground from **NMEA VTG** datagrams may also be copied into the position output datagram. These values may be useful in filtering of the positioning during postprocessing. If a VTG datagram does not follow the GGA or GGK datagram the course and speed fields of the output datagrams will be set to their invalid values.

The "Standard deviation of semi-major axis of error ellipse" field in a **NMEA GST** datagram may also be copied to the position output datagram as its "Measure of position fix quality". It will then replace the use of the HDOP or DOP field in the GGA or GGK datagram respectively to derive this field. This must be enabled by the operator however, and then if the GST datagram does not follow the GGA or GGK the quality measure field of the output datagram will be set to its invalid value.

As an alternative to GGA, the **SIMRAD 90 format** position datagram may be used. The SIMRAD 90 format is intended to be the format of choice when the positioning system is not a stand-alone GPS receiver supplying GGA or GGK format datagrams. The SIMRAD 90 format can in addition to global longitude latitude coordinates also be used for Northing Easting type projection coordinates (e.g. UTM).

To cater for applications where the EM 2000 or EM 3000 Sonar Head is mounted on a subsea vehicle, the original SIMRAD 90 format has been expanded to allow inclusion of the depth of the vehicle in addition to its horizontal position in longitude latitude or Northing Easting coordinates.

Also for EM 2000 and EM 3000 applications with separate surface and underwater positioning systems, the SIMRAD 90 format will allow the underwater position to be provided relative to the vessel, with the vessel surface position given in a separate GGA, GGK or SIMRAD 90 datagram.

GGA Datagram

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always GGA,	–	–
UTC of position	hhmmss.ss,	000000 to 235959.9...	–
Latitude in degrees and minutes, plus optional decimal minutes	llll.ll,	0000 to 9000.0...	–
Latitude – N/S	a,	N or S	–
Longitude in degrees and minutes, plus optional decimal minutes	yyyyy.yy,	00000 to 18000.0...	–
Longitude – E/W	a,	E or W	–
GPS quality indicator	x,	0 to 8	1
Number of satellites in use	xx,	00 to 12	–
HDOP	x.x,	0 to	1
Antenna altitude re mean sea level (geoid)	x.x,	–	2
Units of antenna altitude	M,	–	–
Geoidal separation (sea level re WGS–84)	x.x,	–	2
Units of geoidal separation	M,	–	–
Age of differential GPS data	x.x,	–	–
Differential reference station id	xxxx,	0000 to 1023	–
Possible extension of datagram with user defined data (addition to NMEA format)	c– –c	–	3
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

The HDOP (Horizontal Dilution Of Precision) value will be scaled and copied to the ”Measure of position fix quality” field in the position output datagram. The scale factor depends upon the GPS quality indicator’s value:

- 1 - (SPS or standard GPS) => 1000
- 2 - (differential GPS) => 100
- 3 - (PPS or precise GPS) => 200, but 10 if GGA is treated as RTK. (See Note 2)
- 4 - (kinematic GPS with fixed integers) => 10
- 5 - (kinematic GPS with floating integers) => 50
- 6 - (estimated or dead reckoning mode) => 1000

- 7 - (manual input mode) => 1000
- 8 - (test mode) => 1000, but 10 if GGA is treated as RTK. (See Note 2)
- The ”Measure of position fix quality” field will be set to 65534 (largest valid number) if the indicator is zero (non-valid position).

Note 2

This scaling is used to give at least a relatively correct position fix quality change (in the order of cm) if there are dropouts in differential, precise or kinematic measurements, although HDOP is not a meter value.

Note 3

When the quality factor is 4 or 5 a height output datagram is automatically generated, and also if the quality factor is 3 or 8 and the operator has set the GGA position to be an RTK position. The height is the sum of these two fields which are assumed positive upwards (antenna above geoid).

The maximum length of this field should is restricted so that the total datagram length is not more than 127 bytes.

GGK Datagram

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always GGK,	–	–
UTC time of position	hhmmss.ss,	000000 to 235959.99...	–
UTC date of position	MMDDYY,	010100 to 123199	–
Latitude in degrees and minutes, plus optional decimal minutes	llll.llllll,	0000 to 9000.0...	–
Latitude – N/S	a,	N or S	–
Longitude in degrees and minutes, plus optional decimal minutes	yyyyy.yyyyyy,	00000 to 18000.0...	–
Longitude – E/W	a,	E or W	–
GPS quality indicator	x,	0 to 3	1
Number of satellites in use	xx,	00 to 12	–
DOP	x.x,	0 –	1
Antenna ellipsoidal height	x.x,	–	–
Units of antenna ellipsoidal height	M,	–	–
Possible extension of datagram with user defined data	c––c	–	2
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

The DOP (Dilution Of Precision) value will be scaled and copied to the ″Measure of position fix quality″ field in the position output datagram. The scale factor depends upon the GPS quality indicator′s value:

- 1 (SPS or standard GPS) => 1000
- 2 (differential GPS) => 100
- 3 (kinematic GPS) => 10

The ″Measure of position fix quality″ field will be set to 65534 (largest valid number) if the indicator is zero (non-valid position).

This scaling is used to give at least a relatively correct position fix quality change (in cm) if there are dropouts in differential, precise or kinematic measurements, although DOP is not a meter value.

Note 2

The maximum length of this field should is restricted so that the total datagram length is not more than 127 bytes.

GST Datagram

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always GST,	–	–
UTC time of the GGA or GGK associated with this sentence	hhmmss.ss,	000000 to 235959.9...	–
RMS value of the standard deviation of the range inputs to the navigation process	x.x,	0 –	–
Standard deviation of semi–major axis of error ellipse in meters	x.x,	0 –	1
Standard deviation of semi–minor axis of error ellipse in meters	x.x,	0 –	–
Orientation of semi–major axis of error ellipse in degrees from true North	x.x,	0 –	–
Standard deviation of latitude error in meters	x.x,	0 –	–
Standard deviation of longitude error in meters	x.x,	0 –	–
Standard deviation of altitude error in meters	x.x,	0 –	–
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

The term ”standard deviation of error” in the format description implies that the GST datagram was originally intended to contain statistics. Such a use may invalidate the intended use here, namely to derive a better quality measure than the HDOP in the GGA or DOP in the GGK datagram. Thus, the GST datagram should only be used if one is certain that this field contains the semi-major axis of the error ellipse for the latest fix, and not a statistical measure calculated over a number of fixes.

VTG Datagram

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always VTG,	–	–
Course over ground, degrees true	x.x,T,	0 to 359.9...	1
Course over ground, degrees magnetic	x.x,M,	0 to 359.9..	1
Speed over ground, knots	x.x,N,	0 –	1
Speed over ground, km/h	x.x,K,	0 –	1
Mode indicator	a	A,D,E,M,S or N	–
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

Only true course and the first valid speed field will be used.

Simrad 90 Datagram

Data Description	Format	Length	Valid range	Note
Start identifier = $	Always 24h	1	–	–
Talker identifier	aa	2	Capital letters	–
Sentence formatter	Always S90,	4	–	–
Date of position	DDMMYY,	7	010100 to 311299	–
UTC of position as hour, minute, second, hundredth of second	hhmmssss,	9	00000000 to 23595999	–
Latitude in degrees, minutes and decimal minutes	xxxx.xxxx	9	0000.0000 to 9999.9999	A
Hemisphere identifier	a,	2	N or S	A
Longitude in degrees, minutes and decimal minutes, or depth in meters	xxxxx.xxxx	10	00000.0000 to 18000.0000	A
Hemisphere or depth identifier	a,	2	E, W or D	A
Northing or range in meters	xxxxxxxxx.x,	12	000000000.0 to 999999999.9	B

Data Description	Format	Length	Valid range	Note
Easting or depth in meters	xxxxxxx.x,	10	0000000.0 to 9999999.9	B
UTM zone number	xx,	3	01 to 60	–
User defined central meridian longitude or bearing	xxxxx.xxxx	10	00000.0000 to 35999.9999	C
Hemisphere or bearing identifier	a,	2	E, W, or B	C
System descriptor	x,	2	0 to 7	1
Position fix quality indicator	x,	2	0 to 9 and A to F	2
Speed over ground in m/s	xx.x,	5	00.0 to 99.9	3
Course over ground in degrees	xxx.x	5	000.0 to 359.9	3
End of sentence delimiter = ,CRLF	Always 2Ch 0Dh 0Ah	3	–	–

Note 1

Value of system descriptor defines content of datagram as follows. (Note that the Kongsberg Simrad EM 12, the EM 950 and the EM 1000 multibeam echo sounders will only accept values less than 3):

1 The position is longitude latitude in global coordinates given in the fields noted A.

2 The position is Northing Easting on the Northern hemisphere given in the fields noted B. If the projection is defined to be UTM the UTM zone number or a user definable central meridian longitude may be given in the field noted C.

3 As for system descriptor equal to 1, but the position is on the Southern Hemisphere.

4 As for system descriptor equal to 0, but in addition the depth is given in the Easting field noted B.

5 As for system descriptor equal to 1, but in addition the depth is given in the longitude field noted A.

6 As for system descriptor equal to 2, but in addition the depth is given in the longitude field noted A.

7 The position is given relative to the vessel in a polar coordinate system with horizontal range and depth provided in the fields noted B and bearing re true North in the field noted C.

8 As for system descriptor 6, but the bearing is re the vessel centerline.

Note 2

The position fix quality given in the position output datagram will be derived from the quality indicator (this differs from the original definition of the format) as follows (in m):

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
0.01	0.02	0.05	0.1	0.2	0.5	1	2	5	10	20	50	100	200	500	1000

Note 3

If these fields have valid values they will be copied to equivalent fields in the position output datagram. They may be used in filtering of the positioning during postprocessing. (The original definition of the format had line heading in the course field and its use was to orient real-time displays).

Tide input

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	a	Capital letter	–
Sentence formatter	Always TIDE,	–	–
Date and time of prediction / measurement	YYYYMMDDhhmm,	199601010000 to 999912312359	–
Tide offset in meters and decimal meters	x.x	±327.66	1
Optional checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

A negative number will be assumed to indicate an increase in sea level.

Depth or height input

Data Description	Format	Valid range	Note
Start identifier = *	Always 2Ah	–	–
Sentence identifier	ii	00 to 09	1
Talker identifier	ii	00 to 99	–
Depth or height in meters and decimal meters	x.x	–	2
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

A sentence identifier equal to 00 is used for underwater vehicle depth, all other identifiers are customer specific (usually a datum height).

Note 2

If input is depth, it will be used in the depth output datagram to offset the transmit transducer depth. If input is height, which will usually imply a time or position variable datum height, its use will depend on the sentence identifier and will be implemented as required by a specific customer. Depth is positive downwards. Depths may be scaled and offset by operator settable constants:

output_depth [m] = scale_factor * (input_depth - offset)

2.3 Attitude data

Overview

Attitude data is generally accepted on one or more serial input port(s) as:

- roll, pitch, heave and heading on one port,

or

- roll, pitch and heave on one port and heading separately on another port.

The data update rate should be commensurate with the expected dynamics of the vessel (typically up to 100 Hz).

The acceptable format for roll, pitch, heave and optionally also heading is a 10 byte long message originally defined in the EM 1000 for use with digital motion sensors. It is supported by the following sensors:

- Applied Analytics POS/MV
- Photokinetics Octans
- Seatex MRU
- Seatex SeaPath
- TSS DMS-05

Heading will be accepted in the NMEA 0183 HDT format or in the format used by the Simrad Robertson SKR80(82) gyrocompass. A current loop to RS-232 converter may then be required. The Lemkuhl LR40(60) Scan Repeater format is also accepted, as it is the same as that of the SKR80 with the exception of an extra status byte. Note that if the attitude sensor is capable of reading the gyrocompass and transfer the heading to the attitude sensor datagram (if it does not measure heading itself), this is preferable to interfacing the gyrocompass directly to the system.

Roll, pitch and heading in the Sperry Marine MK-39 MOD2 Attitude and Heading Reference System format is also accepted. A second motion sensor must then be used to supply heave.

Attitude data may be supplied from more than one sensor. All data may be logged, but only one set as chosen by the operator will be used in real time.

EM Attitude input format

The EM attitude format is a 10-bytes long message defined as follows:

- Byte 1: Sync byte 1 = 00h, or Sensor status = 90h-AFh
- Byte 2: Sync byte 2 = 90h
- Byte 3: Roll LSB
- Byte 4: Roll MSB
- Byte 5: Pitch LSB
- Byte 6: Pitch MSB
- Byte 7: Heave LSB
- Byte 8: Heave MSB
- Byte 9: Heading LSB
- Byte 10: Heading MSB

where **LSB** = least significant byte, **MSB** = most significant byte.

All data are in 2's complement binary, with 0.01° resolution for roll, pitch and heading, and 1 cm resolution for heave.

- Roll is positive with port side up with ±179.99° valid range
- Pitch is positive with bow up with ±179.99° valid range
- Heave is positive up with ±9.99 m valid range
- Heading is positive clockwise with 0to 359.99° valid range.

Non-valid data are assumed when a value is outside the valid range.

How roll is assumed to be measured is operator selectable, either with respect to the horizontal plane (the Hippy 120 or TSS convention) or to the plane tilted by the given pitch angle (i.e. as a rotation angle around the pitch tilted forward pointing x-axis). The latter convention (called Tate-Bryant in the POS/MV documentation) is used inside the system in all data displays and in logged data (a transformation is applied if the roll is given with respect to the horizontal).

Note that heave is displayed and logged as positive downwards (the sign is changed) including roll and pitch induced lever arm translation to the system's transmit transducer.

This format has previously been used with the EM 950 and the EM 1000 with the first synchronisation byte always assumed to be zero. The sensor manufacturers have been requested to include sensor status in the format using the first synchronisation byte for this purpose. It is thus assumed that:

- **90h** in the first byte indicates a valid measurements with full accuracy
- any value from **91h to 99h** indicates valid data with reduced accuracy (decreasing accuracy with increasing number)
- any value from **9Ah to 9Fh** indicates non-valid data but normal operation (for example configuration or calibration mode)
- and any value from **A0h to AFh** indicates a sensor error status

Sperry Mk.39 Attitude input format

The format is 18 bytes long, and it is organised as 9 words. The most significant byte of a word is transmitted first.

- Word 1 AA55h
- Word 2 Status and time
- Word 3 Heading
- Word 4 Roll
- Word 5 Pitch
- Word 6 Heading rate
- Word 7 Roll rate
- Word 8 Pitch rate
- Word 9 Checksum (MSB) and 1's complement of checksum (LSB)

All data are in 2's complement binary. Heading is given within ±180°, roll and pitch within ±90°. (Note however that the values +180° and +90° are not permitted, as these are one bit too high.)

Heading is measured with reference to true North, and positive when the bow points eastwards. Roll is per definition a rotation angle (Tate-Bryant) and positive when the starboard side goes up. Pitch is positive when the bow goes down.

HDT format

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always HDT,	–	–
Heading, degrees true	x.x,T	0 to 359.9...	–
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

SKR80 format

The SKR80 sends out a stream of data with four bytes for each measurement. There is one byte for each digit:

- The first byte for the decimal degree (Example: xxx.X)
- The second for the degree (Example: xxX.x)
- The third for the 10's degree (Example: xXx.x)
- The fourth for the 100's degree (Example: Xxx.x)

The two uppermost bits of a byte are always zero, the next two bits give the digit, 00 for the decimal, 01 for the degree, 10 for the 10's degree, and 11 for the 100's degree. The lowest four bits give the digit value in 4-bit BCD format. As an example a heading of 234.5° will give the four bytes 05h 14h 23h 32h. The LR40 adds a fifth byte at the end for status with the two upper bits of the status byte set to 11 (11000000 for OK, 11001010 for alarm). This status byte is ignored.

2.4 Clock

The system clock is used to time stamp all data output. The clock may be set upon start of new survey or power-up on the Processing Unit (recommended source is a NMEA ZDA format datagram). The clock will drift, typically some seconds per day, unless it is synchronised to a 1 PPS (pulse per second) input signal (the clock millisecond counter will be set to zero whenever a pulse is received). A fully correct clock is only necessary if the output data are later to be combined with other time critical data logged or created by other systems, for example an accuracy of up to one minute would be necessary to apply tidal changes. If the timestamp supplied in the position input datagrams is to be used, it is imperative that the system clock is correctly set and that 1 PPS synchronisation is used.

ZDA format

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always ZDA,	–	–
UTC	hhmmss.ss,	000000 to 235959.9...	–
Day	xx,	01 to +31	–
Month	xx,	01 to +12	–
Year	xxxx,	0000 to 9999	–
Local zone hours	xx,	−13 to +13	1
Local zone minutes	xx	00 to +59	1
Optional checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

Local zone time is not used. An offset time may be entered by the operator to get the system clock to show a different time than UTC.

2.5 Sound speed

Overview

A sound speed profile may be loaded into the Operator Station either on a serial line or on Ethernet. Formats previously used with existing Kongsberg Simrad echo sounders (Kongsberg Simrad ASCII and Binary Sound Velocity Profile input datagrams) will be accepted, but since their resolution in depth is limited to 1 m and the number of entries to 100, a new format given below without these limitations is recommended. This format is also accepted by the Kongsberg Simrad HIPAP and HPR underwater positioning systems (but not necessarily vice-versa). Note that a complete profile may be pieced together from several datagrams and edited with the Operator Station's Sound Speed Editor.

The new format is completely in ASCII and allows 9998 entries without limitations in resolution. In addition to depth and sound speed, it allows input of absorption coefficient, pressure, temperature and salinity or conductivity. The latter parameters may be used to calculate depth, sound speed and absorption coefficient. Use of a depth dependent absorption coefficient allows a more accurate determination of bottom backscatter strength.

Note that this datagram may also be logged as output, retaining information not included in the standard sound speed profile output datagram, such as where and when the profile has been taken.

Kongsberg Simrad SSP format

Data Description	Format	Length	Valid range	Note
Start identifier = $	Always 24h	1	–	–
Talker identifier	aa	2	Capital letters	–
Datagram identifier	Always Sxx,	4	S00to S53	1,2
Data set identifier	xxxxx,	6	00000 to 65535	–
Number of measurements = N	xxxx,	5	0001 to 9999	–
UTC time of data acquisition	hhmmss,	7	000000 to 235959	3
Day of data acquisition	xx,	3	00 to 31	3
Month of data acquisition	xx,	3	00 to 12	3

Data Description	Format	Length	Valid range	Note
Year of data acquisition	xxxx,	5	0000 to 9999	3
N entries of the next 5 fiields – See note 4				
– Depth in m from water level or Pressure in MPa	x.x,	2 –	0 to 12000.00 0 to 1.0000	–
– Sound velocity in m/s	x.x,	1 –	1400 to 1700.00	–
– Temperature in °C	x.x,	1 –	–5 to 45.00	–
– Salinity in parts per thousand or Conductivity in S/m	x.x,	1 –	0 to 45.00 0 to 7.000	–
Absorption coefficient in dB/km	x.x	0 –	0 to 200.00	–
Data set delimiter	CRLF	2	0Dh 0Ah	–
End of repeat cycle				
Latitude in degrees and minutes, plus optional decimal minutes	llll.ll,	Variable 5–	0000 to 9000.0...	5
Latitude – N/S	a,	2	N or S	5
Longitude in degrees and minutes, plus optional decimal minutes	yyyyy.yy,	Variable 6–	00000 to 18000.0...	5
Longitude – E/W	a,	2	E or W	5
Atmospheric pressure in MPa	x.x,	1 –	0 to 1.0000	5
User given comments	c– –c	Variable	–	5
Optional checksum	*hh	–	–	6
End of datagram delimiter = \CRLF	5Ch 0Dh 0Ah	3	–	–

Note 1

The datagram identifier identifies what type of data is included. This is shown in the following table where D is depth, P is pressure, S is salinity, C is conductivity, c is sound speed, α is absorption coefficients, and L is latitude. The notation c(T,S) indicates for example that the sound speed is to be calculated from the temperature and salinity input data. When pressure is used, the atmospheric pressure must be given if the pressure is absolute, otherwise the pressure must be given re the sea level and the atmospheric pressure must be zero.

Identifier	Input data	Data to be used
S00	D, c	D, c
S10	D, c	D, c
S11	D, c, α	D, c, α
S12	D, c, T, S	D, c, α(D,T,S,L)
S20	D, T, S	D, c(D,T,S,L)
S21	D, T, S, α	D, c(D,T,S,L), α
S22	D, T, S	D, c(D,T,S,L), α(D,T,S,L)

Identifier	Input data	Data to be used
S30	D, T, C	D, c(D,T,C,L)
S31	D, T, C, α	D, c(D,T,C,L), α
S32	D, T, C	D, c(D,T,C,L), α(D,T,C,L)
S40	P, T, S	D(P,T,S,L), c(P,T,S,L)
S41	P, T, S, α	D(P,T,S,L), c(P,T,S,L), α
S42	P, T, S	D(P,T,S,L), c(P,T,S,L), α(P,T,S,L)
S50	P, T, C	D(P,T,C,L), c(P,T,C,L)
S51	P, T, C, α	D(P,T,C,L), c(P,T,C,L), α
S52	P, T, C	D(P,T,C,L), c(P,T,C,L) , α(P,T,C,L)

Note 2

S00 is a special case because then the sound speed profile will be taken into use immediately without further operator intervention. The checksum is then mandatory and must be correct. Furthermore entries for zero depth and a deeper depth than expected during the survey must be included.

Note 3

Note that these fields have fixed length and leading zeros must be used.

Note 4

The depth or pressure field is always required while the other fields are optional except for those required by the datagram identifier. The field-delimiting commas must always be included even if the fields are empty.

Note 5

The positions, atmospheric pressure and comment fields are optional. Note that the option field must not include a \. It is recommended to include sensor type in the comment field.

Note 6

The checksum field is calculated between the $ and the * delimiters by exclusive OR'ing of all bytes. The checksum is required for datagram S00, but is optional for the others.

AML CALC format

Sound speed profile data input in the CALC format is used by the Applied Microsystems Ltd. (AML) Total System Software package to support AML's complete range of sensors is also accepted.

This format is an ASCII format with a five line header plus a variable number of lines with data as follows:

Line 1: CALC, sn, date, depthincrement, depthdisplay

- sn is the sensor serial number

- date is current date taken from computer
- depthincrement is logging depth increment
- depthdisplay is depth units (meters or decibars)

Line 2: AML SOUND VELOCITY PROFILER S/N: xxxxx

Line 3: DATE:xxxxx TIME:xxxxx

- This line gives the Julian date and time at start of sensor logging

Line 4: DEPTH OFFSET(M): xxxx.x

- This line gives the pressure offset at sea level.

Each line of data contains three numbers:

- depth (in meters)
- sound velocity (in m/s)
- temperature (in degrees Celcius)

Line 5: DEPTH(M) VELOCITY (M/S) TEMPERATURE (_C)

The numbers are separated by a space, and each line is terminated with a linefeed (LF). The numbers shall all include a decimal point (xxx.x xxxx.x xx.xLF). The data are terminated by a line with three zeros with two spaces between the zeros (0 0 0).

AML Smart Sensor format

The **AML Smart SV&P** sensor and later the **SVPlus** sensor may be used directly for sound speed profile input on serial line to the Operator Station. Both these sensors may also be used to measure the sound speed at the transducer depth continuously during the surveying.

A measurement is requested from a smart sensor by issuing the word 'scan' as four ASCII characters terminated by CR. The reply from the SV sensor is a string of ASCII characters:

'S'CRLF xxxx.x CRLF>

where xxxx.x is the measured sound speed in m/s (in bytes 5-11). From the SV&P sensor the received string is:

'S'CRLF ±xxx.xx xxxx.x CRLF>

where the first number is the pressure in decibars relative to the surface and the second sound speed in m/s (in bytes 13-19).

Smart sensors with autonomous output may also be used, both P&SV (sound speed with pressure) and T&SP (sound speed with temperature).

The P&SV format is:

```
±xxx.xx xxxx.x CRLF
```

The T&SP format is:

```
±xx.xxx xxxx.x CRLF
```

The last field in both of these formats give the sound speed and the first field either pressure in decibars or temperature in degrees Celcius.

2.6 Depth input from single beam echo sounder

Overview

Depth datagrams from a single beam echo sounder are accepted for display and logging on the system. The following formats are supported:

- NMEA 0183 DBS
- NMEA 0183 DPT
- binary datagrams from the Kongsberg Simrad EA 500 echo sounder series.

DBS format

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always DBS,	–	–
Depth in feet	x.x,f,	0.1 –	1
Depth in meters	x.x,M,	0.1 –	1
Depth in fathoms	x.x,F	0.1 –	1
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

The decoding priority will be meter field, feet field and fathom field with the depth value extracted from the first field with valid data.

DPT format

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Sentence formatter	Always DPT,	–	–
Depth in meters from the transducer	x.x,	0.1 –	–
Offset of transducer from waterline in meters	x.x,	0 –	1
Maximum range scale in use	x.x	–	–
Checksum	*hh	–	–
End of sentence delimiter = CRLF	Always 0Dh 0Ah	–	–

Note 1

A negative value implying that the offset is from the keel should not be used.

EA 500 format

Data Description	Format	Valid range	Note
Start identifier = D	Always 34h	–	–
Channel identifier	x,	1 to 3	1
Time as HHMMSShh	xxxxxxxx,	00000000 to 23595999	1
Depth in meters from the transducer	32 bit IEEE 754 floating point	0.1 –	1
Bottom backscattering strength in dB	32 bit IEEE 754 floating point	–	–
Transducer number	32 bit integer	–	–
Athwartship slope in degrees	32 bit IEEE 754 floating point	–	–

Note 1

Only the channel identifier, depth and time will be decoded by the system. The least significant byte is transmitted first (the Intel convention).

Note ! *The datagram must be sent on Ethernet to UDP port number 2200 on the Operator Station.*

2.7 Remote control

Overview

A Remote Control datagram has been implemented to allow:

- the multibeam echo sounder to start logging on remote command.
- the multibeam echo sounder to send out parameter and sound speed profile datagrams as a response to the remote command.
- the survey line numbers to be remotely settable.

Note that the parameter and sound speed profile datagrams are always sent out when logging is started or any changes are made to the parameters or sound speed. They may also be sent out regularly at operator specified intervals.

The datagram currently only allows survey related parameters to be transferred to the system. It will later be expanded to allow remote setting of all installation parameters, and then basically as a copy of the standard start/stop datagram with identical conventions with regard to order (which is not important), but requiring only the parameters actually to be set.

Data Description	Format	Valid range	Note
Start identifier = $	Always 24h	–	–
Talker identifier	aa	Capital letters	–
Datagram identifier	Rxx,	R00 to R20	1
EM model number	EMX=dddd,	–	2
Responsible operator	ROP=a––a,	–	–
Survey identifier	SID=a––a,	–	–
Survey line number	PLN=d..d,	–	–
Survey line identifier (planned line no)	PLL=d––d,	–	–
Comment	COM=a––a	–	–
Optional checksum	*hh	–	–
End of datagram delimiter = \CRLF	5Ch 0Dh 0Ah	–	–

Note 1

Rxx defines what action the system is to take with respect to pinging and logging of data in addition to changes in the parameters. Note that logging of survey data on local storage is not affected, this is determined by operator control from the menu only.

- R00 - System to stop pinging (and logging if on)
- R10 - System to stop all logging (but continue or start pinging).
- R11 - System to start logging on new line to both local and remote
- R12 - System to star logging on new line but only to local storage
- R13 - System to start logging on new line but only to remote
- R20 - System to send installation parameter datagram and sound speed profile datagrams to remote

Note 2

The EM model number will be required when parameter changes are made with respect to transducer location or system gain settings.

3 OUTPUT DATAGRAMS

3.1 Overview

Output datagrams are usually logged to disk or tape on the EM Series Operator Station. The output datagrams may also be exported to user provided programs on the Operator Station or on an external Ethernet network using UDP protocol (remote logging). An NMEA DPT depth datagram may be exported on a serial line.

The output datagrams are mostly in binary format using signed or unsigned integer numbers with lengths of 1, 2 or 4 bytes. All binary data will presently be big endian.

Note ! *As this is subject to modifications, we recommend that software written to decode EM Series data includes a check for the byte ordering with a provision for byte swapping. Suitable data fields to check on are the length field at the start of the datagram, the EM Series model number field and possibly the date and time fields.*

The basic output datagram structure established with the EM 100 echo sounder is retained.

- All datagrams (except the NMEA DPT datagram) start with STX, datagram type and time tag, and end with ETX and checksum (sum of bytes between STX and ETX). In addition the total length of the datagram *(not including the length field)* will precede the STX byte, given as a four byte binary number.
- The length field is only included when logging to tape and/or disk, but not for datagrams logged to a remote location. The length can then be derived from the network software. Systems logging data remotely should add this length at the start of each datagram. This length is required if the data are to be used with Kongsberg Simrad post-processing systems.
- The time stamp resolution has been increased to 1 millisecond and now includes the century, but as a consequence the time stamp is now binary and not ASCII as implemented previously. The date is given as 10000*year(4 digits) + 100*month + day, for example 19950226 for February 26, 1995. All date fields in the output datagrams use this format. A time is usually given (in milliseconds) from midnight.
- The datagrams identify the multibeam echo sounder model and its serial number. The system model number is 120 for the EM 120, 300 for the EM 300, etc. For the EM 3000D (the dual head system) the model number was originally given as 3002 and the serial number is that of Sonar Head number 1. However in the depth datagram model numbers 3003-3008 are now used to also identify the actual transmit and sampling frequencies of the two heads. If only one head is activate on the EM 3000D, it is coded as a single head system.

- Due care has been taken to include all parameters needed in postprocessing in the relevant datagrams, with a minimum of data duplication. Where resolution of a data field is variable, a resolution descriptor is included.
- Invalid data are always identified by the highest positive number allowed in a field unless otherwise noted.
- A real-time parameter datagram has been added to enable logging of parameters not used in postprocessing, but which may be important in checking the quality of the logged data, or to allow tracing of reasons for possible malfunctions.
- Attitude data as time continuous records and raw ranges and beam pointing angles are logged to allow eventual postprocessing corrections. The logged attitudes are valid at the transmit transducer, and are corrected for any sensor offsets.

3.2 Depth

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = D(epth data) (Always 44h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	4
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Ping counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Heading of vessel in 0.01°	2U	0 to 35999	–
Sound speed at transducer in dm/s	2U	14000 to 16000	–
Transmit transducer depth re water level at time of ping in cm	2U	0 to 65536	1
Maximum number of beams possible	1U	48 –	–
Number of valid beams = N	1U	1 to 254	–
z resolution in cm	1U	1 to 254	–
x and y resolution in cm	1U	1 to 254	–
Sampling rate (f) in Hz **or** Depth difference between sonar heads in the EM 3000D	2U 2S	300 to 30000 −32768 to 32766	3 4
Repeat cycle – N entries of :	16*N	–	–
– Depth (z) from transmit transducer (unsigned for EM 120 and EM 300)	2S or 2U	−32768 to +32766 or 1 to 65534	2

Data Description	Format	Valid range	Note
– Acrosstrack distance (y)	2S	−32768 to 32766	2
– Alongtrack distance (x)	2S	−32768 to 32766	2
– Beam depression angle in 0.01°	2S	−11000 to 11000	3
– Beam azimuth angle in 0.01°	2U	0 to 56999	3
– Range (one−way travel time)	2U	0 to 65534	3
– Quality factor	1U	0 to 254	5
– Length of detection window (samples) (Example: −20 dB = 216)	1U	1 to 254	–
– Reflectivity (BS) in 0.5 dB resolution/4)	1S	−128 to +126	–
– Beam number	1U	1 to 254	6
End of repeat cycle			
Transducer depth offset multiplier	1S	−1 to +17	1
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The transmit transducer depth plus the depth offset multiplier times 65536 cm should be added to the beam depths to derive the depths re the water line. The depth offset multiplier will usually be zero, except when the EM 2000/3000 Sonar Head is on an underwater vehicle at a depth larger than 655.36 m. Note that the offset multiplier will be negative (-1) if the actual heave is large enough to bring the transmit transducer above the water line. This may represent a valid situation, but may also be due to an erroneously set installation depth of either the transducer or the water line.

Note 2

The beam data are given re the transmit transducer or sonar head depth and the horizontal location of the active positioning system's antenna. Heave, roll, pitch, sound speed at the transducer depth and ray bending through the water column have been applied. On the EM 1002/2000/3000 the beam depths must be regarded as signed values to take into account beams which may be going upwards. On the EM 120/300 the beam depths are always positive and the values are therefore unsigned.

Note 3

The range, beam depression angle (positive downwards and 90° for a vertical beam) and beam azimuth angle (re vessel centerline) are given relative to the transducer (sonar head) at the ping transmit time. Heave, roll, pitch and sound speed at the transducer depth have been applied, but not ray bending. These values may thus be directly used for a new ray bending calculation with a revised sound speed profile to generate new sounding depths and positions without any need for using attitude data. The range resolution in time is the inverse of the range sampling rate (i.e. nominally equivalent to about 70 μs for the EM 3000).

Note that if the data need to be reprocessed with a new sound speed at the transducer depth or new roll, pitch or heave values, full reprocessing starting with the raw range and beam angle data is required. Attitude data is also required in this reprocessing, and both these data types will in the future be logged as standard.

If the beam azimuth angle has a value larger than 35999, the beam pointing angle has replaced the beam depression angle, and the raw two-way travel time has replaced the one-way heave and beam angle corrected travel time. The transmit tilt angle plus 54000 is given in the beam azimuth angle field. The use of this data definition is available on remote output to a port named as "RawDepth..." for use by other systems which do their own attitude and sound speed processing.

Note 4

In an EM 3000D the transmit transducer depth is that of Sonar Head number 1, taking into account the depth offset multiplier as described in note 1. The range multiplier is replaced by the difference in depth between Sonar Head number 1 and 2, i.e. head 2 depth is equal to head 1 depth (possibly modified with depth offset multiplier) plus the depth difference. The range sampling rates in Hz of the two heads is given through the EM model number according to the following table:

EM model number	3003	3004	3005	3006	3007	3008
Sonar Head 1	13956	14293	13956	14621	14293	14621
Sonar Head 2	14621	14621	14293	14293	13956	13956

Previously the model number of the EM 3000D was given as 3002 with head sample rates of 13956 and 14621 Hz respectively. The head depths in this case should be assumed to be equal, and although the mathematical derivation of final beam depths would elsewise be the same as described above, the transmit transducer depth was not actually exactly that of the sonar heads.

Note 5

The quality number's upper bit signifies whether amplitude (0) or phase (1) detection has been used. If amplitude the 7 lowest bits give the number of samples used in the centre of gravity calculation. If phase the second highest bit signifies whether a second (0) or first (1) order curve fit has been applied to determine the zero phase range, and the 6 lowest bits indicates the quality of the fit (actually the normalized variance of the fit re the maximum allowed, i.e. with a lower number the better the fit).

Note 6

Beam 128 is the first beam on the second sonar head in an EM 3000D dual head system.

3.3 Raw range and beam angle

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = F (Always 46h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Ping counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Maximum number of beams possible	1U	48 –	–
Number of valid beams = N	1U	1 to 254	–
Sound speed at transducer in dm/s	2U	14000 to 16000	–
Repeat cycle – N entries of :	8*N	–	
– Beam pointing angle in 0.01°	2S	–11000 to 11000	1
– Transmit tilt angle in 0.01°	2U	–2999 to 2999	1
– Range (two–way travel time)	2U	0 to 65534	1
– Reflectivity (BS) in 0.5 dB resolution	1S	–128 to 126	–
– Beam number	1U	1 to 254	–
End of repeat cycle			
Spare (Always 0)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The beam pointing angle is positive to port and the transmit tilt angle is positive forwards for a normally mounted system looking downwards. The range resolution in time is the inverse of the range sampling rate given in the depth datagrams.

3.4 Seabed image

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = S(eabed image data) (Always 53h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–

Data Description	Format	Valid range	Note
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234	4U	0 to 86399999	–
Ping counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Mean absorption coefficient in 0.01 dB/km	2U	1 to 20000	1
Pulse length in μs	2U	50 –	1
Range to normal incidence used to correct sample amplitudes in no. of samples	2U	1 to 16384	–
Start range sample of TVG ramp if not enough dynamic range (0 else)	2U	0 to 16384	–
Stop range sample of TVG ramp if not enough dynamic range (0 else)	2U	0 to 16384	–
Normal incidence BS in dB (BSN) (Example: −20 dB = 236)	1S	−50 to 10	–
Oblique BS in dB (BSO) (Example: −1 dB = 255)	1S	−60 to 0	–
Tx beamwidth in 0.1°	2U	1 to 300	–
TVG law crossover angle in 0.1°	1U	20 to 300	–
Number of valid beams (N)	1U	1 to 254	–
Repeat cycle – N entries of :	6*N	–	
– beam index number	1U	0 to 253	2
– sorting direction	1S	−1 or 1	3
– number of samples per beam = Ns	2U	1 –	–
– centre sample number	2U	1 –	4
End of repeat cycle			
Repeat cycle – ΣNs entries of:	ΣNs	–	
– Sample amplitudes in 0.5 dB (Example: −30 dB = 196)	1S	−128 to 126	–
End of repeat cycle			
Spare byte if required to get even length (Always 0 if used)	0−1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

These fields have earlier had other definitions.

Note 2

The beam index number is the beam number - 1.

Note 3

The first sample in a beam has lowest range if 1, highest if -1. Note that the range sampling rate is defined by the sampling rate in the depth output datagram and that the ranges in the seabed image datagram are all two-way from time of transmit to time of receive

Note 4

The centre sample number is the detection point of a beam.

3.5 Central beams echogram

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = K (Always 4Bh)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Ping counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Mean absorption coefficient in 0.01 dB/km	2U	1 to 20000	1
Pulse length in μs	2U	50 –	1
Range to normal incidence used in TVG	2U	1 to 16384	1
Start range sample of TVG ramp if not enough dynamic range (0 else)	2U	0 to 116384	–
Stop range sample of TVG ramp if not enough dynamic range (0 else)	2U	0 to 16384	–
Normal incidence BS in dB (BSN) (Example: −20 dB = 236)	1S	−50 to +10	1
Oblique BS in dB (BSO) (Example: −1 dB = 255)	1S	−60 to 0	1
Tx beamwidth in 0.1°	2U	1 to 300	1
TVG law crossover angle in 0.1°	1U	20 to 300	1
Number of included beams (N)	1U	1 –	–
Repeat cycle – N entries of :	6*N	–	
– beam index number	1U	0 to 253	2
- spare byte to get even length (Always 0)	1U	–	–
- number of samples per beam = Ns	2U	1 -	–
- start range in samples	2U	1 -	3
End of repeat cycle			
Repeat cycle – ΣNs entries of:	ΣNs	–	
– Sample amplitudes in 0.5 dB (Example: −30 dB = 196)	1S	−128 to +126	–
End of repeat cycle			
Spare byte if required to get even length (Always 0 if used)	0–1U	–	–

Data Description	Format	Valid range	Note
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The sample amplitudes are not corrected in accordance with the detection parameters derived for the ping, as is done for the seabed image data.

Note 2

The beam index number is the beam number - 1.

Note 3

The range for which the first sample amplitude is valid for this beam given as a two-way range. The detection range is given in the raw range and beam angle datagram. Note that data are provided regardless of whether a beam has a valid detection or not.

3.6 Position

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = P(osition data) (Always 050h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Position counter (sequential counter)	2U	0 to 65535	–
System / serial number	2U	100 –	–
Latitude in decimal degrees*20000000 (negative if southern hemisphere) (Example: 32°34’ S = –651333333)	4S	–	–
Longitude in decimal degrees*10000000 (negative if western hemisphere) (Example: 110.25° E = 1102500000)	4S	–	–
Measure of position fix quality in cm	2U	–	1
Speed of vessel over ground in cm/s	2U	0 –	1
Course of vessel over ground in 0.01°	2U	0 to 35999	1
Heading of vessel in 0.01°	2U	0 to 35999	–
Position system descriptor	1U	1 to 254	2
Number of bytes in input datagram	1U	– 254	–
Position input datagram as received	Variable	–	3

Data Description	Format	Valid range	Note
Spare byte if required to get even length (Always 0 if used)	0–1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

These data will be valid only if available as input.

Note 2

The position system descriptor shows which source this data is from and its real-time use by bit coding:

- xxxx xx01 - position system no 1
- xxxx xx10 – position system no 2
- xxxx xx11 – position system no 3
- 10xx xxxx – the position system is active, system time has been used
- 11xx xxxx - the position system is active, input datagram time has been used
- xxxx 1xxx – the position may have to be derived from the input datagram which is then in SIMRAD 90 format.

Note 3

Complete input datagram except header and tail (such as NMEA 0183 $ and CRLF).

3.7 Height

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = h(eight data) (Always 068h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (EXample: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Height counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Height in cm	4S	–4294967296 to 4294967295	–
Heigth type	1U	0 to 99	1
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The height type is as given in the height input datagram unless it is zero. Then the height is derived from the GGK or GGA datagram and is the height of the water level re the vertical datum (possibly motion corrected).

3.8 Tide

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = T(ide data) (Always 054h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Tide counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Date = year*10000 + month*100 + day (from input datagram) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (from input datagram) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Tidal offset in cm	2S	−32768 to 32766	–
Spare (Always 0)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

3.9 Attitude

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = A(ttitude data) (Always 041h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (at start of data record) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (at start of data record) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–

Data Description	Format	Valid range	Note
Attitude counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Number of entries = N	2U	1 –	–
Repeat cycle – N entries of:	12*N	–	
– Time in milliseconds since record start	2U	0 to 65534	–
– Sensor status	2U	–	1
– Roll in 0.01°	2S	−18000 to 18000	–
– Pitch in 0.01°	2S	−18000 to 18000	–
– Heave in cm	2S	−1000 to 10000	–
– Heading in 0.01°	2U	0 to 35999	–
End of repeat cycle			
Sensor system descriptor	1U	–	2
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The sensor status will be copied from the input datagram's two sync bytes if the sensor uses the EM format, and from the sensor's status word if it is a Sperry Mk39. See the input format description for further details.

Note 2

The sensor system descriptor will show which sensor the data is derived from, and which of the sensor's data have been used in real time by bit coding:

- xx01 xxxx – motion sensor number 1
- xx10 xxxx – motion sensor number 2
- xxxx xxx1 – heading from the sensor is active
- xxxx xx0x – roll from the sensor is active
- xxxx x0xx – pitch from the sensor is active
- xxxx 0xxx – heave from the sensor is active

3.10 Heading

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = H(eading data) (Always 048h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–

Data Description	Format	Valid range	Note
Date = year*10000 + month*100 + day (at start of data record) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (at start of data record) (System: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Heading counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Number of entries = N	2U	1 –	–
Repeat cycle – N entries of:	4*N	–	–
– Time in milliseconds since record start	2U	0 to 65534	–
– Heading in 0.01°	2U	0 to 35999	–
End of repeat cycle			
Heading indicator (active or not) (0 = inactive)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

3.11 Mechanical transducer tilt

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	
Start identifier = STX (Always 02h)	1U	–	
Type of datagram = J (Always 4Ah)	1U	–	
EM model number (Example: EM 1002 = 1002)	2U	–	
Date = year*10000 + month*100 + day (at start of data record) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (at start of data record) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Tilt counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Number of entries = N	2U	1 –	–
Repeat cycle – N entries of:	4*N	–	
– Time in milliseconds since record start	2U	0 to 65534	–
– Tilt in 0.01 degrees	2S	−1499 to +1499	1
End of repeat cycle			
Spare (Always zero)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

This tilt angle is the measured mechanical tilt of a hull unit such as that often supplied with the EM 1002. It is positive when the transducer is tilted forewards.

3.12 Clock

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = C(lock data) (Always 043h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (of EM clock) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (of EM clock) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Clock counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Date = year*10000 + month*100 + day (from external clock input) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (from external clock datagram) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
1 PPS use (active or not) (0 = inactive)	1U	–	1
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

Shows if the system clock is synchronised to an external 1 PPS signal or not.

3.13 Surface sound speed

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = G (Always 047h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (at start of data record) (Example: Feb 26, 1995 = 19950226)	4U	–	–

Data Description	Format	Valid range	Note
Time since midnight in milliseconds (at start of data record) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Sound speed counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Number of entries = N	2U	1 –	–
Repeat cycle – N entries of:	4*N	–	
– Time in seconds since record start	2U	0 to 65534	–
– Sound speed in dm/s (including offset)	2U	14000 to 15999	–
End of repeat cycle			
Spare (Always 0)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

3.14 Sound speed profile

This datagram will contain the profile actually used in the real time raybending calculations to convert range and angle to xyz data. It will usually be issued together with the installation parameter datagram.

Note ! *The format as given below has been changed from previous editions of this manual. The former format is identified by its type which was "V" (056h). The previous format had 2 byte long fields for depth and sound speed, this is now 4 bytes.*

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = U (Always 055h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (at start of use) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (at start of use) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Profile counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Date = year*10000 + month*100 + day (when profile was made) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (when profile was made) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–

Data Description	Format	Valid range	Note
Number of entries = N	2U	1 –	–
Depth resolution in cm	2U	1 to 254	–
Repeat cycle – N entries of:	8*N	–	–
- Depth	4U	0 to 1200000	–
– Sound speed in dm/s	4U	14000 to 17000	–
End of repeat cycle			
Spare byte to get even length (Always 0)	1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

3.15 Kongsberg Simrad SSP output

This datagram will contain the profile as received as input, and is logged as is to enable use of its data in postprocessing. The real time use of its data is decided by the operator, the sound speed profile actually being used is given by the sound speed profile output datagram (see above).

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = W (Always 057h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
SSP counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Input datagram starting with Sentence formatter and ending with Comment	Variable	–	–
Spare byte if required to get even length (Always 0 if used)	0 – 1U	–	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

3.16 Single beam echo sounder depth

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–

Data Description	Format	Valid range	Note
Type of datagram = E(cho sounder data) (Always 045h)	1U	–	–
EM model number (Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (of EM clock) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (of EM clock) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Echo sounder counter (sequential counter)	2U	0 to 65535	–
System serial number	2U	100 –	–
Date = year*10000 + month*100 + day (from input datagram if available) (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (from input datagram if available) (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Echo sounder depth from waterline in cm	4U	0 to 1200000	–
Source identifier (S, T, 1, 2 or 3)	ASCII	–	1
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

Identifies the source datagram type, i.e. NMEA DBS, NMEA DPT or EA 500 series channel 1-3 respectively.

3.17 Runtime parameter

Data Description	Format	Valid range	Note
Number of bytes in datagram	4U	–	–
Start identifier = STX (Always 02h)	1U	–	–
Type of datagram = R(untime parameter) (Always 052h)	1U	–	–
EM model number /Example: EM 3000 = 3000)	2U	–	–
Date = year*10000 + month*100 + day (Example: Feb 26, 1995 = 19950226)	4U	–	–
Time since midnight in milliseconds (Example: 08:12:51.234 = 29570234)	4U	0 to 86399999	–
Ping counter	2U	0 to 65535	–
System serial number	2U	100 –	–
Operator Station status	1U	–	1
Processing Unit status	1U	–	1
BSP status	1U	–	1
Sonar Head or Transceiver status	1U	–	1
Mode	1U	1 –	2
Filter identifier	1U	0 to 254	3

Data Description	Format	Valid range	Note
Minimum depth in m	2U	0 to 10000	–
Maximum depth in m	2U	1 to 12000	–
Absorption coefficient in 0.01 dB/km	2U	1 to 20000	4
Transmit pulse length in μs	2U	1 to 50000	–
Transmit beamwidth in 0.1 degrees	2U	1 to 300	–
Transmit power re maximum in dB	1S	0 to −50	–
Receive beamwidth in 0.1 degrees	1U	5 to 80	–
Receive bandwidth in 50 Hz resolution	1U	1 to 254	–
Receiver fixed gain setting in dB	1U	0 to 50	–
TVG law crossover angle in degrees	1U	2 to 30	–
Source of sound speed at transducer	1U	0 to 3	5
Maximum port swath width in m	2U	10 to 20000	8
Beam spacing	1U	0 to 2	6
Maximum port coverage in degrees	1U	10 to 110	8
Yaw and pitch stabilization mode	1U	–	7
Maximum starboard coverage in degrees	1U	10 to 110	–
Maximum starboard swath width in m	2U	10 to 20000	–
Spare (Always 0)	2U	–	–
HiLo freqency absorption coefficient ratio	1U	00 to 120	–
End identifier = ETX (Always 03h)	1U	–	–
Check sum of data between STX and ETX	2U	–	–

Note 1

The system status will by set bits indicate system faults by bit coding (a fault may not necessarily be detrimental to system performance).

The Operator Station status byte is used as follows:

- 1xxx xxxx - No reply from the Processing Unit.

The Processing Unit status byte is used as follows:

- xxxx xxx1 - Communication error with BSP
- xxxx xx1x - Communication error with Transceiver or Sonar Head
- xxxx x1xx - Attitude not valid for this ping
- xxxx 1xxx - Heading not valid for this ping
- xxx1 xxxx - System clock has not been set since power on
- xx1x xxxx - External trigger signal not detected
- x1xx xxxx - Hull unit not responding

A set bit in the BSP status byte indicates an internal communication problem. On the EM 2000 and EM 3000 problems with the high speed data uplink are specifically indicated as follows:

- xxxx xxx1 - EM 2000, EM 3000 and Sonar Head no 1 on the EM 3000D
- xxx1 xxxx - Sonar Head no 2 on the EM 3000D

The BSP status byte is used as follows by the EM 3000:

- xxxx xxx1 - Ping rejected due to errors in received data on BSP1
- xxxx xx1x - Too much seabed image data on BSP1
- xxxx x1xx - Invalid command received by BSP1
- xxx1 xxxx - Ping rejected due to errors in received data on BSP2
- xx1x xxxx - Too much seabed image data on BSP2
- x1xx xxxx - Invalid command received by BSP2

The Sonar Head status byte is used as follows by the EM 2000 and EM 3000:

- xxxx xxx1 - Temperature too high on Sonar Head 1
- xxxx xx1x - Data link failure on Sonar Head 1
- xxxx x1xx - Voltages out of range on Sonar Head 1
- xxx1 xxxx - Temperature too high on Sonar Head 2 of EM 3000D
- xx1x xxxx - Data link failure on Sonar Head 2 of EM 3000D
- x1xx xxxx - Voltages out of range on Sonar Head 2 of EM 3000D

The Transceiver status byte is used as follows by the EM 120, EM 300 and EM 1002:

- xxxx xxx1 - Transmit (HV) voltage out of range
- xxxx xx1x - PSU voltage out of range
- xxxx x1xx - Internal communication error
- xxxx 1xxx - Receive channel DC offset(s) out of range
- xxx1 xxxx - Internal communication error
- x1xx xxxx - Internal communication error
- 1xxx xxxx - Defective fuse(s) in transmitter

Note 2

The mode identifier byte is used as follows:

- 0000 0000 - Nearfield (EM 3000) or Very Shallow
- 0000 0001 - Normal (EM 3000) or Shallow (default for EM 2000)
- 0000 0010 - Target detect (EM 3000) or Medium
- 0000 0011 - Deep
- 0000 0100 - Very deep

Note 3

The filter identifier byte is used as follows:

- xxxx xx00 - Spike filter set to Off
- xxxx xx01 - Spike filter is set to Weak
- xxxx xx10 - Spike filter is set to Medium
- xxxx xx11 - Spike filter is set to Strong
- xxxx x1xx - Slope filter is on
- xxxx 1xxx - Sector tracking or Robust Bottom Detection (EM 3000) is on
- 0xx0 xxxx - Range gates have Normal size
- 0xx1 xxxx - Range gates are Large
- 1xx0 xxxx - Range gates are Small
- xx1x xxxx - Aeration filter is on
- x1xx xxxx - Interference filter is on

Note 4

The used absorption coefficient should be derived from the seabed image or central beams echogram datagram if it is automatically updated with changing depth.

Note 5

The sound speed (at the transducer depth) source identifier is used as follows :

- 0000 0000 - From real time sensor
- 0000 0001 - Manually entered by operator
- 0000 0010 - Interpolated from currently used sound speed profile

Note 6

The beamspacing identifier is used as follows:

- 0000 0000 - Determined by beamwidth (FFT beamformer of EM 3000)
- 0000 0001 - Equidistant
- 0000 0010 - Equiangle
- 0000 0011 - Equiangle around nadir, equidistant further out

Note 7

The yaw and pitch stabilization identifier is set as follows:

- xxxx xx00 - No yaw stabilization
- xxxx xx01 - Yaw stabilization to survey line heading
- xxxx xx10 - Yaw stabilization to mean vessel heading
- xxxx xx11 - Yaw stabilization to manually entered heading
- 1xxx xxxx - Pitch stabilization is on.

Note 8

Port swath width and coverage was in earlier versions the sum of port and starboard

3.18 Installation parameters

This datagram is an ASCII datagram except for the header which is formed as in all other output datagrams. The datagram is issued as a start datagram when logging is switched on and as a stop datagram when logging is turned off, i.e. at the start and end of a survey line. It may also be sent to a remote port as an information datagram. It is usually followed by a sound speed profile datagram.

In the datagram all ASCII fields start with a unique three character identifier followed by "=". This should be used when searching for a specific field as the position of a field within the datagram is not guaranteed. The number or character part following is in a variable format with a minus sign and decimal point if needed, and with "," as the field delimiter. The format may at any time later be expanded with the addition of new fields at any place in the datagram.

For the EM 3000 the transducer 1 data are for the Sonar Head and the transducer 2 data are for the second Sonar Head of an EM 3000D. For other new EM systems with separate transmit and receive transducers, transducer 1 refers to the transmit transducer, and transducer 2 refers to the receive transducer.

Data Description	Example	Format	Valid range	Note
Number of bytes in datagram	–	4U	–	1
Start identifier = STX	Always 02h	1U	–	–
Type of datagram = I or i(nstallation parameters) or r(emote information)	Start = 049h Stop = 069h Remote info = 70h	1U	–	–
EM model number	EM 3000 = 3000	2U	–	–
Date = year*10000 + month*100 + day	Feb 26, 1995 = 19950226	4U	–	–
Time since midnight in milliseconds	08:12:51.234 = 29570234	4U	0 to 86399999	–
Survey line number	–	2U	0 to 65534	–
System serial number	–	2U	100 –	–
Serial number of second sonar head	–	2U	100 –	–
Water line vertical location in m	WLZ=x.x,	ASCII	–	–
System main head serial number	SMH=x.x,	ASCII	100 –	1
Hull Unit	HUN=x	ASCII	0 or 1	–
Hull Unit tilt offset	HUT=x.x	ASCII	–	–

Data Description	Example	Format	Valid range	Note
Transducer 1 vertical location in m	S1Z=x.x,	ASCII	–	–
Transducer 1 along location in m	S1X=x.x,	ASCII	–	–
Transducer 1 athwart location in m	S1Y=x.x,	ASCII	–	–
Transducer 1 heading in degrees	S1H=x.x,	ASCII	–	–
Transducer 1 roll in degrees re horizontal	S1R=x.x,	ASCII	–	–
Transducer 1 pitch in degrees	S1P=x.x,	ASCII	–	–
Transducer 1 no of modules	S1N=x––x,	ASCII	–	–
Transducer 2 vertical location in m	S2Z=x.x,	ASCII	–	–
Transducer 2 along location in m	S2X=x.x,	ASCII	–	–
Transducer 2 athwart location in m	S2Y=x.x,	ASCII	–	–
Transducer 2 heading in degrees	S2H=x.x,	ASCII	–	–
Transducer 2 roll in degrees re horizontal	S2R=x.x,	ASCII	–	–
Transducer 2 pitch in degrees	S2P=x.x,	ASCII	–	–
Transducer 2 no of modules	S2N=x––x,	ASCII	–	–
System (sonar head 1) gain offset	GO1=x.x,	ASCII	–	–
Sonar head 2 gain offset	GO2=x.x,	ASCII	–	–
Outer beam offset	OBO=x.x	ASCII	–	–
High/Low Frequency Gain Difference	FGD=x.x	ASCII	–	–
Transmitter (sonar head no1) software version	TSV=c––c,	ASCII	–	2
Receiver (sonar head 2) software version	RSV=c––c,	ASCII	–	2
BSP software version	BSV=c––c,	ASCII	–	2
Processing unit software version	PSV=c––c,	ASCII	–	2
Operator station software version	OSV=c––c,	ASCII	–	2
Datagram format version	DSV=c––c,	ASCII	–	2
Depth sensor time delay in millisec	DSD=x––x,	ASCII	–	–
Depth sensor offset	DSO=x.x,	ASCII	–	–
Depth sensor scale factor	DSF=x.x,	ASCII	–	–
Depth sensor heave	DSH=aa,	ASCII	IN or NI	3
Active position system number	APS=x,	ASCII	0 to 2	7
Position system 1 motion compensation	P1M=x,	ASCII	0 or 1	4
Position system 1 time stamp used	P1T=x,	ASCII	0 or 1	5
Position system 1 vertical location in m	P1Z=x.x,	ASCII	–	–
Position system 1 along location in m	P1X=x.x,	ASCII	–	–
Position system 1 athwart location in m	P1Y=x.x,	ASCII	–	–
Position system 1 time delay in seconds	P1D=x.x,	ASCII	–	–
Position system 1 geodetic datum	P1G=c––c,	ASCII	–	–
Position system 2 motion compensation	P2M=x,	ASCII	0 or 1	4
Position system 2 time stamp use	P2T=x,	ASCII	0 or 1	5
Position system 2 vertical location in m	P2Z=x.x,	ASCII	–	–
Position system 2 along location in m	P2X=x.x,	ASCII	–	–

Data Description	Example	Format	Valid range	Note
Position system 2 athwart location in m	P2Y=x.x,	ASCII	–	–
Position system 2 time delay in seconds	P2D=x.x,	ASCII	–	–
Position system 2 geodetic datum	P2G=c––c,	ASCII	–	–
Position system 3 motion compensation	P3M=x,	ASCII	0 or 1	4
Position system 3 time stamp use	P3T=x,	ASCII	0 or 1	5
Position system 3 vertical location in m	P3Z=x.x,	ASCII	–	–
Position system 3 along location in m	P3X=x.x,	ASCII	–	–
Position system 3 athwart location in m	P3Y=x.x,	ASCII	–	–
Position system 3 time delay in seconds	P3D=x.x,	ASCII	–	–
Position system 3 geodetic datum	P3G=c––c,	ASCII	–	–
Position system 3 on serial line or Ethernet	P3S= x,	ASCII	0 for Ethernet	–
Motion sensor 1 vertical location in m	MSZ=x.x,	ASCII	–	–
Motion sensor 1 along location in m	MSX=x.x,	ASCII	–	–
Motion sensor 1 athwart location in m	MSY=x.x,	ASCII	–	–
Motion sensor 1 roll reference plane	MRP=aa,	ASCII	HO or RP	–
Motion sensor 1 time delay in milliseconds	MSD=x––x,	ASCII	–	–
Motion sensor 1 roll offset in degrees	MSR=x.x,	ASCII	–	–
Motion sensor 1 pitch offset in degrees	MSP=x.x,	ASCII	–	–
Motion sensor 1 heading offset in degrees	MSG=x.x,	ASCII	–	–
Motion sensor 2 vertical location in m	NSZ=x.x,	ASCII	–	6
Motion sensor 2 along location in m	NSX=x.x,	ASCII	–	6
Motion sensor 2 athwart location in m	NSY=x.x,	ASCII	–	6
Motion sensor 2 roll reference plane	NRP=aa,	ASCII	HO or RP	6
Motion sensor 2 time delay in milliseconds	NSD=x––x,	ASCII	–	6
Motion sensor 2 roll offset in degrees	NSR=x.x,	ASCII	–	6
Motion sensor 2 pitch offset in degrees	NSP=x.x,	ASCII	–	6
Motion sensor 2 heading offset in degrees	NSG=x.x,	ASCII	–	6
Gyrocompass heading offset in degrees	GCG=x.x,	ASCII	–	–
Roll scaling factor	MAS=x.x,	ASCII	–	–
Transducer depth sound speed source	SHC=x	ASCII	0 or 1	8
Active heading sensor	AHS=x,	ASCII	1 to 4	–
Active roll sensor	ARO=x,	ASCII	1 to 4	–
Active pitch sensor port no	API=x,	ASCII	1 to 4	–
Active heave sensor port no	AHE=x,	ASCII	1 to 4	–
Cartographic projection	CPR=aaa,	ASCII	–	–
Responsible operator	ROP=c––c,	ASCII	–	–
Survey identifier	SID=c––c,	ASCII	–	–
Survey line identifier (planned line no)	PLL=x––x,	ASCII	–	–
Comment	COM=c––c,	ASCII	–	–

Data Description	Example	Format	Valid range	Note
Spare byte if required to get even length	Always 0 if used	0–1U	–	–
End identifier = ETX	Always 03h	1U	–	–
Check sum of data between STX and ETX		2U	–	–

Note 1

Serial number of head no 2 if that head is the only one in use with the EM 3000D, otherwise the serial number of head no 1 in the EM 3000D or the only head in the EM 3000.

Note 2

A version number is given as 3 alphanumerical fields separated by decimal points, plus date as yymmdd (for example 3.02.11 991124).

Note 3

IN = the heave of an underwater vehicle is presumed to be measured by the vehicle's depth sensor and the heave sensor input is not used by system.

Note 4

1 = the positions are motion compensated

0 = the positions are not motion compensated

Note 5

0 = the system has used its own time stamp for the valid time of the positions

1 = the system has used the time stamp of the position input datagram (external time).

Note 6

If entries for a second motion sensor are not included although two sensors are being used, they are presumed to have the same parameters.

Note 7

Position system number -1.

Note 8

0 = sound speed is taken from manual entry.

1 = sound speed is taken from current profile.

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