

Format of Deep SOLO X messages: Argo Version Manual/Decoder V0.5
latest update: 11 Jan 2023
(ROM 18Apr2016, 11May16, 01Jul16)

An X message is used to transfer data from ISU to GS or from GS to ISU. The data is assumed to be binary and each byte can have any value from 0x00 to 0xff. The format of the message is the same regardless of direction of transmission:

Xnnmddp<data>\$cc>

- X** = the character **X**
- nn = number of data characters in the message following after nn. The count does not include **X**, nn, or anything from **\$** to the end **>**. The count is in 2 binary bytes with MSB first and LSB second.
- mm = serial number of SOLOII. The SN is in 2 binary bytes with MSB first and LSB second.
- dd = the dive number in 2 binary bytes with MSB first and LSB second.
: Dive number begins at -1 for the start-up, increments to 0 for the test dive, increments +1 for all normal' (0xE2) dives.
- p = one-byte packet ID index, range 0 to 255. Used to identify multiple X messages within a dive cycle. The data for each dive cycle starts with p=0.
- <data> = binary data characters. The length of <data> = nn -5. The contents of the <data> section is described below.
- \$** = a dollar sign delimiter at start of the checksum
- cc = the 8 bit byte-wise checksum from **X** to the byte preceding the **\$**. The 8 bit sum is coded as 2 4bit nibbles. The binary value of a nibble is converted to a visible character by adding 0x30. Thus a value of 0x0 -> 0x30 = character '0', 0x1 -> 0x31 = '1', 0xe -> 0x3e = '>', and 0xf -> 0x3f = '?'.
- >** = a > delimiter at end of checksum which also serves as a prompt to GS that the ISU is done transmitting and that the GS may now transmit to ISU.

The remainder of this document describes the format of the <data> portion of the message sent from SOLOII to the ground station (**GS**). The format of commands from **GS** sent to SOLOII will be described in another document.

Highlights in document (previous DEEP float version = v0.4)

Fields that are moved relative to the previous DEEP float version are highlighted in cyan

New fields relative to the DEEP previous version are highlighted in yellow

The <data> section contains information from multiple sensors. Data from successive sensors are separated by a semicolon (';' = 0x 3b); the final sensor is terminated by a ';' (immediately preceding the \$ delimiter).

IDjj<sensor_data>;
ID = one-byte sensor ID code.
 jj = Number of bytes for this sensor. The count includes **ID**, jj, and the trailing ;.
 The count is in 2 binary bytes with MSB first and LSB second.
 <sensor_data> = binary data characters. The length of <sensor_data> = jj-4 bytes, and its contents are described below for each sensor.
 ; = delimiter at the end of each sensor's data.

The **ID** byte is divided into two 4-bit nibbles. The MS nibble identifies the sensor and the second nibble specifies the message number for that sensor. For example, the ID for first Pressure message is 0x10, the second is 0x11, the third 0x12, etc. For a 1000 sample profile, there will be 6 messages for each of the pressure, salinity and temperature sensors.

| Sensor | ID byte(hex) | |
|-----------------------------|--------------|--|
| GPS | 00 | fix at end of first diagnostic dive at start of mission |
| GPS | 01 | fix at before leaving surface |
| GPS | 02 | fix at end of normal profiling ascent |
| GPS | 03 | fix following mission abort |
| GPS | 05 | fix during BITest |
| Pressure | 1x | depths of CTD readings x=0-7: upper ocean bin averaged data x=8-F: deep spot sampled data |
| Temperature | 2x | depth series of temperature x=0-7: upper ocean bin averaged data x=8-F: deep spot sampled data |
| Salinity | 3x | depth series of salinity x=0-7: upper ocean bin averaged data x=8-F: deep spot sampled data |
| Fall Rate | 4x | series of time, depth during SOLO II downward profile |
| Rise Rate | 5x | series of time, depth from drift depth to surface |
| Pump Series | 6x | pressure, time, voltage, current, vacuum for each pump |
| Time | 7x | depth series of time-referenced to 0x40; x=8-F: Only returned during deep spot sampling |
| High Resolution Pressure | 9x | High Resolution Pressure [x=0-7] |
| High Resolution Temperature | ax | High Resolution Temperature [x=0-7] |
| High Resolution Salinity | bx | High Resolution Salinity [x=0-7] |
| Drift Profile Pressure | 9x | Drift profile of Pressure [x=8-F] |
| Drift Profile Temperature | ax | Drift profile of Temperature [x=8-F] |
| Drift Profile Salinity | bx | Drift profile of Salinity [x=8-F] |
| Mission EEPROM | d0 | ASCII dump of mission parameters in EEPROM [x=0-d] |
| Mission EEPROM | de | Config Echo |
| Engineering | e0 | diagnostic data in first diagnostic dive |
| Engineering | e2 | engineering data in normal profiling dive |
| Engineering | e3 | engineering data following mission abort |
| Engineering | e5 | engineering data BIT test |
| Argo Data | f0 | Mission parameter list |
| Test pattern | f1 | <i>ID reserved, format not yet defined</i> |

GPS data (ID=0x00, 0x01, 0x02, 0x03, 0x05)

The LS nibble of the ID indicates in what phase of the mission the fix was taken. The remainder of the data is the same for all mission phases. The length of GPS data is in bytes 1 and 2. GPS fix data starts in byte 3:

| Byte | Contents |
|-------------|---|
| 0 | Mission phase: 0 = 1st diagnostic dive at the start of a mission 1 = beginning of normal dive cycle (just before leaving surface) 2 = end of a normal dive cycle 3 = following mission abort 5 = during BITest |
| 1-2 | Number of bytes in the message, 24 = 0x18 with the format as described here |
| 3 | 0 if fix is invalid, +2 if longitude is East, -2 if longitude is West |
| 4-7 | Signed latitude degrees * 1e7 |
| 8-11 | Signed longitude degrees * 1e7 range (+180 to -180 degrees) |
| 12-13 | GPS week (traditional GPS week =0 to 1023 in LS 10 bits; rollover fix in MS 6 bits) |
| 14 | GPS day of week, 0=Sunday, 6=Saturday |
| 15 | UTC hour |
| 16 | UTC minutes |
| 17 | Time to get fix = (seconds to get fix)/10 , range 0 to 255 = 0 to 2550 seconds |
| 18 | Number of satellites used in fix |
| 19 | Minimum signal level |
| 20 | Average signal level |
| 21 | Maximum signal level |
| 22 | 10*Horiz. dilution of precision |
| 23 | ; terminator (0x3B) |

Pressure data (ID=0x1n)

Temperature data (ID=0x2n)

Salinity data (ID=0x3n)

Time data (ID=0x7n)

Profile data from the pressure, temperature, and salinity sensors are all processed in the same way and the message format differs only in the ID code. The SeaBird CTD takes a profile as the SOLO-D ascends/descends and stores the values internally. When SOLO-D reaches the surface/park pressure, it takes the continuously sampled data (0-2000dbar) data from the CTD and block averages it in depth into PRO_BINS (= 1000) bins. Data sampled deeper than 2000dbar is recorded in spot sampled mode and returned in different messages. Time of the spot sampled data is also returned.

The size of depth bins can vary with depth. The averaging scheme is determined by 5 parameters: **BLOK**, **PB1**, **PB2**, **AV1**, and **AV2**. The smallest bin size is **BLOK** decibars. Bins 0 thru **PB1**-1 have a vertical extent of **BLOK** decibars. Bins **PB1** thru **PB2**-1 are **AV1*BLOK** decibars tall while bins **PB2** thru **PRO_BINS**-1 are **AV2*BLOK** decibars. In the special case that **PB1** >= **PRO_BINS**, then all of the bins are **BLOK** decibars in extent, and the values of **PB2**, **AV1**, and **AV2** are ignored.

There are two options for packing the Core (bin averaged and discrete) profile data. Which ever packing is requested is returned within the data stream within the first nibble of the jj variable (see below).

1. Difference Packing

The data series from all channels are processed in the same way and are synchronous with each other. Each depth series is broken into sub-blocks of 25 samples, and a first-differencing method is applied to each sub-block to reduce the number of bytes required to transmit the data. Because the data series will generally be longer than the 189 bytes available in a 9601 SBD message, it is divided into multiple messages. Each message has an integral number of sub-blocks in it. The final sub-block of the time series may have fewer than 25 samples in it. The data message looks like:

IDjj<sub-block 0><sub-block 1> . . . <sub-block m>;
ID = one-byte sensor ID code and index. The low order hex digit is the message index for this sensor. For example, the pressure messages would have ID's:10,11,12...
jj = Profile Packing Format (MS nibble)/Number of bytes for this message (LS 3 nibbles). Profile Packing Format = 0 for Legacy Diff. (backwards compatible), 1 for Curv. Number of bytes count includes ID, jj, the data, and the trailing ;.
<sub-block i> = first-differenced data from the ith sub=block where i=1,...,m =number of sub-blocks. If i<m, the sub-block will have 25 values in it and will have a total length of 22 bytes. The mth sub-block will have between 1 and 25 values and a length between 3 and 27 bytes.

Suppose a sub-block has the n values v[0], v[1],...v[n-1]. Then this sub-block will be transmitted as:

| Sub-block Byte | Contents |
|----------------|--|
| 0 | one-byte scaling factor S, range = 1 to 255. S is chosen so that the scaled first-differences fit in one byte, i.e. diff <= 127. |
| 1 | MS byte of v[0] |
| 2 | LS byte of v[0] |
| 3 | LS byte of { v[1] - v[0] }/S |
| 4 | LS byte of { v[2] - v[1] }/S |
| ... | |
| n+1 | LS byte of { v[n-1] - v[n] }/S |

2. Curvature Packing (New to V0.4 and later)

The packing routine is introduced to reduce the volume of transmitted data, primarily by allowing for variation in the bytes allotted for the data. The bytes allotted will be constant within a 16 value sub-block, but will differ between parameters and between sub-blocks of the same parameter.

IDjjBNNVVVDDDpppppppppppp<sub-block 0><sub-block 1> . . . <sub-block sb>;

ID = one-byte sensor ID code and index. The low order hex digit is the message index for this sensor. For example, the pressure messages would have ID's:10,11,12... and message index (m) of 0, 1, 2, ...

jj = Profile Packing Format (MS nibble)/Number of bytes for this message (LS 3 nibbles). Profile Packing Format = 0 for Legacy Diff. (backwards compatible), 1 for Curv. Number of bytes count includes ID, jj, the data, and the trailing ;.

B = count of first sub-block number in message, as 1 byte. For message index, m = 0, B=0, for succeeding messages m > 0, B > 0. The position (n) of the first value recorded in a message (VVV) can be computed as $TopIdx = m + B*16$, where m is the message index.

NN = total number of values given in the message as 2 bytes.

VVV = $v[n=TopIdx]$ first value as 3 binary bytes. In all messages greater than 1, VVV will be the same value as the last value packed in the previous message.

DDD = $\{v[n=TopIdx+1] - v[n=TopIdx]\}$ first-differenced, second value as 3 bytes.

pppppppppppp = (12 bytes) packing factors for the sub-block second differences where each 3 bits indicate the dynamic range for each sub-block. The packing factor will be the number of nibbles needed to represent the dynamic range of the variable. For example, if the range is from 7 to -7, then the value can be expressed unambiguously using 1 nibble and the packing factor would be 0. Using 12 bytes for the packing factors, there can be up to 32 sub-blocks, or 512 values if the packing factor is 0 (1 nibble). Unfilled factors are valued at 0.

<sub-block i> = $\{ v[n+2+i*16] - 2*v[n+1+i*16] + v[n+i*16] \}$
 where n=0,...,15 and i=1,...,sb =number of sub-blocks.

Each non-last sub-block (i=1:sb-1) will have 16 values in it and will have a total length of 8 to 32 bytes. The last sub-block (i=sb) will have between 1 and 16 values and a length between 1 and 32 bytes. Message index m > 1 (example ID=11) overlap the previous message index m-1 by 1 value. Thus the VVV value in message index m will be redundant with the last value from message index m-1. If all sub-blocks are full in message index m, then the message contains values for index $n = m + (B - 1) * 16$ through $n = 1 + m + (B - 1 + sb_m) * 16$, where sb_m is be the number of sub-blocks in the message m.

Suppose sub-block i has n values $v[2+i*16], v[3+i*16], \dots, v[n+2+i*16]$, and the packing factor = 1 Then this sub-block will be transmitted as:

| Sub-block Byte | Contents |
|----------------|---|
| 0 | $v[2+i*16] - 2*v[1+i*16] + v[i*16]$ |
| 1 | $v[3+i*16] - 2*v[2+i*16] + v[1+i*16]$ |
| | |
| n | $v[n+2+i*16] - 2*v[n+1+i*16] + v[n+i*16]$ |

Within a message, the original values can then be reconstructed by (1) starting with DDD and doing a cumulative sum of the entries for the sub-blocks, and then (2) using these values and starting with VVV doing a second cumulative sum.

Fall Rate data (ID=0x4n, n=0:f)

As it falls from the surface to its drift depth, SOLOII periodically interrogates the SeaBird for a depth reading. This time series is sent back in this data message.

The data message looks like:

IDjj<start_time><time(1),depth(1)> . . . <time(m),depth(m)>;

ID = one-byte sensor ID code = 0x40.

jj = Fall Packing Format (MS nibble)/Number of bytes in the message (LS 3 nibbles). Fall Packing Format = 0 for Legacy 4 byte reporting (backwards compatible), 1 for 5 byte reporting. The count includes **ID**, **jj**, the data, and the trailing ;.

start_time = SOLO time at start of fall (seconds since 1Jan2000) in 4 bytes (MSB first).

time(i) = time since **start_time** in 2 bytes, i=1, ..., m, (resolution of 10 seconds;)

code(i) = Code representing float phase while data value recorded in 1 nibble, i=1, ..., m.

Possible Phase codes values

| | |
|------------------------------------|-------|
| Last of Continuous profile records | =0, |
| START_OF_SINK | =1, |
| Buoyancy at 200db | =2, |
| SEEK | =3, |
| BEGINNING_OF_DRIFT | =4, |
| SEEK_DURING_DRIFT | =5, |
| END_OF_SINK | =6, |
| START_OF_RISE | =7, |
| END_OF_RISE | =8, |
| TURN_AROUND | =9, |
| SINKING | =10, |
| DRIFTING | =11, |
| RISING | =13, |
| SURFACE | =14 ; |

time resolution =10 s/count

depth(i) = depth (LSB=0.1 db) at **time(i)** in 2.5 bytes, i=1, ..., m.

dBar = 0.1 * **depth(i)** -10

depth(i) = 0xffff if the pressure reading is invalid

Each depth observation takes 5 bytes. The first time is taken when the valve is opened to leave the surface. The next two times are when the float passes 50m and 100m. After 100 m, pressures are logged every 30 minutes. The SOLO-D logs values every <SkSLsc> s during the continuous-profile. Others are recorded at: the same time as the first spot sample; at the end of sink(); at the beginning of each seek(); and at the beginning of park().

Fall Rate data can be found over multiple messages.

Rise Rate data (ID=0x5n, n=0:f)

The rise rate message is identical in structure to the fall rate message. For the SOLOII, the rise rate time series begins as its valve is opened to descend from the drift depth to the profile depth. It logs a pressure/time record 10 times during its descent to the profile depth (interval = PwaitN/10). At the bottom of dive, whether determined by timing out (exceeding PwaitN) or by reaching the target depth (ZproN), another pressure/time record is logged. At this point, the float pumps for PmpBtm seconds. A pressure/time record is logged every 30 minutes while the float is ascending. Rise Rate data can be found over multiple messages.

For the SOLO-D the rise rate time series begins at the end of park() (start of ascend()), sampling periodically (<AsSLsc>), until the surface is reached. time resolution =10 s/count.

Pump data (ID=0x6n, n=0:f)

. The data message looks like:

IDjj< depth(1),time(1),voltage(1),current(1),vac0(1),vac1(1)> . . .
< depth(m),time(m),voltage(m),current(m),vac0(m),vac1(m);
 ID = one-byte sensor ID code = 0x60.
 jj = Pump Packing Format (MS nibble)/Number of bytes in the message (LS 3 nibbles). Pump Packing Format = 0 for Legacy 10 byte packing (backwards compatible), 1 for 11 byte packing.
code(i) = Code representing float phase in 1 nibble, i=1, ..., m (See Fall for values).
depth(i) = depth (LSB=0.1 db) at time(i) in 2.5 bytes, i=1, ..., m.
 dBar = .1 * depth(i) -10. This is the depth when the pump STARTED.
 depth(i) = 0xffff if the pressure reading is invalid
 time(i) = seconds the pump ran in 2 bytes (signed)
 voltage(i) = average pump battery counts while pumping in 2 bytes (0.01V)
 current(i) = average pump current at bottom in 2 bytes, LSB=1ma
 vac0(i) = vacuum counts after pump starts in 1 byte
 vac1(i) = vacuum counts before pump stops in 1 byte
 t_mn(i) = (2 bytes) time[minutes] since start-of-fall that this pump event STOPPED.

Pump time series can be found over multiple messages.

Engineering data (ID=0xe0, 0xe2, 0xe3, 0xe5, 0xe6)

The engineering data is used to diagnose SOLOII/SOLO-D anomalies. A different format is used in each of the distinct phases of a SOLOII/SOLO-D mission. The LS nibble of the ID indicates the phase of the mission.

| Byte | Contents |
|---------|--|
| 0 | ID/Mission phase: 0xe0 = 1st diagnostic dive at the start of a mission 0xe2 = end of a normal dive cycle 0xe3 = following mission abort 0xe5 = BITtest 0xe6 = BITfailed |
| 1-2 | Number of bytes in the message, depends on mission phase as described below |
| 3 -> ?? | Depends on mission phase as described below |

ALL ID's have the same first four bytes:

| Byte | Contents |
|------|--|
| 0 | ID/Mission phase = 0xen (n=0,2, 3, 5, 6) |
| 1-2 | Number of bytes = 76= 0x4c |
| 3 | Engineering message version =3 |
| 4 | #packets to send in the current session. |

Instead of byte position below, the parameter type is given:

char, uchar = 1-byte field (char = signed, uchar = unsigned).
short, ushort = 2-byte field (short = signed, ushort = unsigned).
string[n] = string of bytes, length n.

ID=0xe6, Engineering message following FailedBITest

| type | Contents |
|--------|---|
| ushort | (starts with same 4 eng. header bytes). BITstatus (failure status) (first two bytes are the bit-fail status) this is followed by the same parameters for a successful BITest (0xe5): |

ID=0xe5, Engineering message following a successful BITest

| type | Contents |
|------------|---|
| | (starts with same 4 eng. header bytes). |
| short | SBE P Offset(*800) |
| short | CPU battery voltage 0.01 V |
| short | no load pump battery voltage 0.01 V |
| short | pump battery voltage counts at end of last pump (0.01V) |
| short | DP->HPavgI = average pump current at bottom, LSB=1ma |
| short | seconds pumped out during test |
| uchar | Oil sensor before filling bladder [0..255 counts] |
| uchar | Oil sensor after filling bladder [0..255 counts] |
| short | DP-> Air[0] = Pcase Vacuum at beginning of BIT. (Oil Bladder Empty) 0.01 inHg |
| short | DP → Air[1] = Pcase Vacuum at end of BIT with air bladder inflated. 0.01 inHg |
| uchar | Number of tries needed to open valve |
| uchar | Number of tries to close valve |
| ushort | i.d. of last interrupt |
| string[30] | string returned from SBE pt command |
| char | ; terminator |

ID=0xe0, Engineering message in 1st diagnostic dive at start of mission (Number of bytes = 76 =0x4C)

| type | Contents |
|-------------|---|
| | (starts with same 4 eng. header bytes). |
| ushort | #tries to connect in last surface session |
| ushort | parse_X_reply status in last surface session |
| ushort | ATSBD return status in last surface session |
| ushort | Seconds taken in sending last SBD message |
| ushort | current CPU battery voltage counts 0.01V |
| ushort | current pump battery counts 0.01V |
| ushort | Pump battery counts at end of last pump 0.01V. |
| ushort | DP->Air[0] = pcase vacuum at beginning of BIT 0.01 inHg |
| ushort | DP->Air[1] = pcase vacuum before bladder full 0.01inHg |
| ushort | DP->Air[2] = pcase vacuum after bladder full 0.01inHg |
| ushort | DP->ISRID = i.d. of last interrupt |
| ushort | HPavgI = avg pump current at bottom, LSB=1 mA. |
| ushort | HPmaxI = max pump current at bottom, LSB = 1 mA. |
| ushort | total pump seconds on ascent. |
| ushort | seconds pumped at the surface. |
| ushort | DP->P[5] = surf press counts @ end of ASCEND (LSB=.1 dBar) |
| ushort | SPRX = Surf press before resetoffset (pertains to prev dive) |
| ushort | SPRXL = press after resetoffset (pertains to prev dive) |
| ushort | diagP[0] = Press when "in water" sensed |
| ushort | diagT[0] = Temp when "in water" sensed |
| ushort | diagS[0] = Salinity when "in water" sensed |
| short | SBnscan = # scans recorded by SBE |
| | // -1 (0xffff) indicates unable to get scan count from SBE |
| | // -2 (0xfffe) indicates SBE never started so SBE didn't reset |
| | // scan count before returning an old value |
| ushort | Compacted SBntry,SBstrt,SBstop status (see misspec.h): ((DP->SBntry&0xf)<<4) ((DP->SBstrt&0x3)<<2) (DP->SBstop&0x3)) |
| ushort | diagP[1] = Shallowest press in profile (not filled) |
| ushort | diagT[1] = Shallowest Temp in profile (not filled) |
| ushort | diagS[1] = Shallowest Salinity in profile (not filled) |
| ushort | BTvac = BIT vacuum in 0.01 inHg |
| ushort | BTPcur = BIT motor current, LSB=1mA |
| ushort | BTPsec = BIT Pump seconds |
| uchar | BTPvac[0] = BIT oil sensor at beginning of test, before pumping |
| uchar | BTPvac[1] = BIT oil sensor after pumping |
| ushort | BTVple = BIT pump batt 0.01V |
| ushort | BTVcpu= BIT CPU batt 0.01V |
| ushort | exception flags |
| uchar | #0.1 seconds vent motor ran |
| uchar | LLD status before/after the vent ran. |
| uchar | AbtCd = code for what caused the abort_miss. |
| char | ; terminator. |

ID=0xe2, Engineering message in normal dive cycle (Number of bytes = 103 =0x67)

| type | Contents |
|-------------|--|
| | (starts with same 4 eng. header bytes). |
| ushort | #tries to connect in last surface session |
| ushort | parse_X_reply status in last surface session |
| ushort | ATSBD return status in last surface session |
| ushort | Seconds taken in sending last SBD message |
| ushort | present CPU battery voltage counts 0.01V |
| ushort | present pump battery counts 0.01V |
| ushort | Pump battery counts at end of last pump 0.01V. |
| ushort | DP->Air[0] = pcase vac during sinking @50db with oil all inside pcase ,0.01 inHg |
| ushort | DP->Air[1] = pcase vacuum before filling oil bladder at surface 0.01 inHg |
| ushort | DP->Air[2] = pcase vacuum after filling bladder at surface 0.01 inHg |
| ushort | DP->ISRID = i.d. of last interrupt |
| ushort | HPavgI = avg pump current at bottom, LSB=1 mA. |
| ushort | HPmaxI = max pump current at bottom, LSB = 1 mA. For SOLO-D, HPmaxI=0 as dummy-fill |
| ushort | total pump seconds on ascent. |
| ushort | seconds pumped at the surface. |
| ushort | SPRX = Surf press before resetoffset (pertains to prev dive) |
| ushort | SPRXL = press after resetoffset (pertains to prev dive) |
| ushort | diagP[0] = Pressure before pumping for ascent |
| ushort | diagT[0] = Temp before pumping for ascent |
| ushort | diagS[0] = Salinity before pumping for ascent |
| ushort | diagP[1] = First (shallowest) Pressure scan on descent |
| ushort | diagT[1] = First (shallowest) Temperature scan on descent |
| ushort | diagS[1] = First (shallowest) Salinity scan on descent |
| ushort | SBnbad = # bad bins from SBE |
| ushort | SBnscan = # scans recorded by SBE // -1 (0xffff) indicates unable to get scan count from SBE // -2 (0xfffe) indicates SBE never started so SBE didn't reset // scan count before returning an old value |
| ushort | Compacted SBntry,SBstrt,SBstop status (see misspec.h): ((DP->SBntry&0xf)<<4) ((DP->SBstrt&0x3)<<2) (DP->SBstop&0x3)) |
| ushort | DP->P[0] = press counts before begin of FALL (LSB =.1 dBar) |
| ushort | DP->P[1] = press counts at end of FALL (LSB = .1 dBar) |
| ushort | DP->P[2] = press counts at beginning of DRIFT (LSB = .1 dBar) |
| ushort | DP->P[3] = press counts at end of DRIFT (LSB = .1 dBar) |
| ushort | DP->P[5] = surf press counts @ end of ASCEND (LSB = .1 dBar) |
| ushort | DP->PAVG[0]=average pressure over first half of DRIFT |
| ushort | DP->TAVG[0]=average temperature over first half of DRIFT |
| ushort | DP->SAVG[0]=average salinity over first half of DRIFT |
| ushort | DP->PAVG[1]=average pressure over second half of DRIFT |
| ushort | DP->TAVG[1]=average temperature over second half of DRIFT |
| ushort | DP->SAVG[1]=average salinity over second half of DRIFT |
| ushort | DP->fall_time = seconds from open air valve to end of settle |
| ushort | DP->fall rate = avg mm/sec while sinking |
| ushort | DP-> SeekT = seconds pumped in 1 st settle to drift |
| ushort | DP-> SeekP = change of depth (signed 0.1 dbar in 1 st settle) |
| ushort | exception flags (can be added) |
| | 0x0001 Valve failed to open |
| | 0x0002 Valve failed to close |
| | 0x0004 Questionable pressure |
| | 0x0008 Antenna was toggled |

| | | |
|--------|--------|---|
| | 0x0010 | Antenna switch failure. (no satellites even after toggling) |
| | 0x0020 | GPS communication error (cannot talk to GPS unit) |
| | 0x0080 | Float took too long to leave the surface. (toggled valve) |
| | 0x1000 | Valve failure during Sink phase of mission |
| | 0x2000 | Valve failure during Ascend phase of mission |
| uchar | | vent data; # 0.1 seconds vent motor ran |
| uchar | | vent data; LLD status before and after vent ran |
| short | | SBE P offset(*800) |
| ushort | | PP->SeekSc; tenths of seconds pumped to target depth |
| ushort | | Number of Packets sent in previous cycle |
| ushort | | DP->W_FALL, last fall velocity in previous cycle (mm/s) |
| ushort | | Z_Neutral = the float's estimated neutrally-buoyant depth (no oil in ext. bladder). |
| char | | Compacted BinMod and SubCycle number: (first 5 bits BinMod, last 3 bits SubCycle) (BinMod & 0x1f << 3) (MP->ThisCycle & 0x7); BinMod options: 0: Breck Curvature Compression binned by SBE 2: Breck Curvature Compression binned by controller (float) 16: Classic Difference Compression binned by SBE 18: Classic Difference Compression binned by controller (float) |
| char | | ; terminator |

ID=0xe3, Engineering message following mission abort

| | |
|-------------|---|
| type | Contents |
| | (starts with same 4 eng. header bytes). |
| ushort | #tries to connect in last surface session |
| ushort | parse_X_reply status in last surface session |
| ushort | ATSBD return status in last surface session |
| ushort | Seconds taken in sending last SBD message |
| ushort | current CPU battery voltage counts 0.01V |
| ushort | current pump battery counts 0.01V |
| ushort | DP->Air[0] = pcase vacuum at end of last xmit (previous cycle) 0.01 inHg |
| ushort | DP->Air[1] = pcase vacuum at beginning of abort 0.01inHg |
| ushort | DP->ISRID = i.d. of last interrupt |
| ushort | AbtCd = code for what caused abort_miss |
| | 0 = no error |
| | 1 = current time is later than RTCabort |
| | 2 = unable to WakeOST |
| | 3 = unable to send Dive number to SOLO II (LOdiveNo) |
| | 4 = Iridium ground station commanded to go to abort |
| | 5 = FnlDiv was completed. Mission is done |
| | 6 = Diagnostic dive failed to get GPS fix, pressure never>dBarGo, or unable to send message to Iridium |
| | 7 = pressure sensor failure |
| char | ; terminator |

Mission EEPROM dump (ID=0xdn, n=0-d)

| Byte | Contents |
|------------|---|
| 0 | ID/Mission phase = 0xd0,0xd1,0xd2,0xd3 [Possible values 0:d] |
| 1-2 | len=Number of bytes (variable, typically 888 for SOLO II) |
| 3- (len-2) | ASCII listing of mission parameters Each EEPROM parameter has a 6 character name and 5 char value: NAMExx=vvvvv The = & signs are present in the listing of each parameter. (15 bytes/parameter) Successive parameters follow without gaps. |
| len-1 | ; terminator at the end of the dump |

An example showing only the initial 3 and final 2 elements follows:

BLOK= 1| PB1= 10| PB2= 1005|... WD_EN = 1| WDhour= 360|;

The EEPROM dump message is sent only in response to a command "P" from the ground station. It is sent over 4 SBD messages. (0xd0=328 bytes, 0xd1=328 bytes, 0xd2=328 bytes, 0xd3=213 bytes.)

Mission Command echo (ID=0xde)

| Byte | Contents |
|------------|--|
| 0 | ID/Mission phase = 0xde |
| 1-2 | len=Number of bytes (includes ID and ;) |
| 3- (len-2) | ASCII listing of mission command received by float |
| len-1 | ; terminator at the end of the echo |

Argo Data ID=0xf0 Relayed in normal cycles

| Byte | Contents |
|-------|---|
| 0 | ID/Mission phase = 0xf0 |
| 1-2 | Number of bytes = 25 = 0x19 |
| 3 | Data Version (Minor version in high order nibble, major version in low order)=0.3 |
| 4-5 | Target profile depth |
| 6-7 | Target parking depth |
| 8-9 | Maximum rise time in minutes |
| 10-11 | Target (maximum) fall to parking depth time in minutes |
| 12-13 | Maximum fall-from-parking-to-profile-depth time in second |
| 14-15 | Target drift time in minutes. V0.3, Apr14: 1 count =5 minutes. |
| 16 | Float Version: 1=Deep SOLO, 0=SOLO |
| 17 | Target ascent rate while profiling |
| 18-19 | Number of seeks |
| 20-21 | Surface Time |
| 22-23 | Seek Interval in minutes |
| 24-25 | SBE_Pgain |
| 26-27 | SBE_Poff |
| 28-29 | SBE_Tgain |
| 30-31 | SBE_Toff |
| 32-33 | SBE_Sgain |
| 34-35 | SBE_Soff |
| 36 | ; terminator |

Test Data (ID=0xf1)

| Byte | Contents |
|------|----------------------------|
| 0 | ID/Mission phase = 0xf1 |
| 1-2 | Number of bytes = variable |
| 3 | modulo |
| 4-n | test data |

Exception Flag (Engineering Message) Table [Value sent by float can be sum from multiple errors]

| Hex | Value | Description | Mission |
|--------|-------|--|------------|
| 0x0001 | 1 | Valve failed to open | Mission |
| 0x0002 | 2 | Valve failed to close | |
| 0x0004 | 4 | Questionable pressure (never did the 50dbar pump) | |
| 0x0008 | 8 | Antenna was toggled after 60 s of no GPS sats | Surface |
| 0x0010 | 16 | Antenna switch failure (no satellites even after toggling) | Surface |
| 0x0020 | 32 | GPS communication error: <u>No GPS</u> | Surface |
| 0x0040 | 64 | No SBE profile bins | |
| 0x0080 | 128 | Took > 10min to leave surface | |
| 0x0100 | 256 | Had to restart SBE to profile-mode | Surface |
| 0x0200 | 512 | did not rise enough in seek (<40% than what we expected) | |
| 0x0400 | 1024 | Excessive Fall Speed: <u>Abort Mission (return to surface immediately)</u> | Fall,Drift |
| 0x0800 | 2048 | Stalled during fall (neutral or on bottom) | |
| 0x1000 | 4096 | Valve failure during Sink phase of mission | |
| 0x2000 | 8192 | Valve failure during Ascend phase of mission | |
| 0x4000 | 16384 | Too many bad pressure values on ascend | |
| 0x8000 | 32768 | | |