AUTOMATED SURFACE OBSERVING SYSTEM (ASOS)

RELEASE NOTE

SOFTWARE VERSION - 2.7B

All Weather Precipitation Accumulation Gauge (AWPAG)

April 20, 2004

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1.0 Introduction

1.1 Background

The Automated Surface Observing System (ASOS) was originally deployed with the Heated Tipping Bucket (HTB) rain gauge as the precipitation accumulation sensor. The HTB uses a heated funnel in an attempt to melt frozen (e.g., snow), freezing (e.g., freezing rain), and mixed precipitation so that the liquid water equivalent of the precipitation can be measured. Unfortunately, it was found that the HTB had a series of limitations that made it ineffective during non-liquid precipitation events. In order to address these limitations, the National Weather Service (NWS) sought a new gauge that would provide improved performance during all types of precipitation. This gauge is the All Weather Precipitation Accumulation Gauge (AWPAG) developed by Ott Hydrometrie of Germany. The AWPAG is currently scheduled to replace the HTB at NWS sponsored ASOS locations.

The AWPAG is a weighing precipitation gauge, and does not use a 0.01 inch tipper like the HTB. The AWPAG will be deployed with a new metal windshield which will replace the vinyl alter shield used with the HTB. (See Appendix A for a photograph and mechanical drawing of the AWPAG.)   The AWPAG is also an "intelligent" gauge that uses internal firmware algorithms to address evaporation, wind turbulence, power outage periods, heating control of the orifice area, sudden rapid unrealistic amount changes caused by non-precipitation events, e.g., animals, and comprehensive maintenance monitoring. (See Appendix B for the functional interface description between the AWPAG and ASOS, and Appendix C for ASOS algorithm processing of the AWPAG messages.)

Once the data are measured by the AWPAG and the minute-by-minute precipitation amounts computed, the precipitation processing algorithms used to generate the ASOS data, products, and messages, are identical to those used for processing the data from the HTB.

The ASOS Acquisition Control Unit (ACU) software that supports the AWPAG is software version 2.7B (v2.7B). This new version was developed using v2.7A as its baseline. ASOS v2.7A supports both the new dewpoint temperature sensor (Vaisala DTS1) and the Ice Free Wind (IFW) sensor (Vaisala 425). All three sensors (DTS1, IFW, and AWPAG) can only interface to the new single board computer processor developed by Synergy Microsystems, Inc., using software v2.7B. To help isolate hardware problems with the new processor board a system maintenance log message, with additional supporting information, was added in v2.7B.

1.2 Purpose

This ASOS Release Note gives a summary of the changes found in ACU application software v2.7B, since v2.7A.

2.0 General Information

The NWS is currently performing Operational Acceptance Tests (OATs) for the IFW and the AWPAG. Some ASOS sites may only have software installed that will support the new sensor for a specific OAT, e.g., v2.7A for IFW. While other sites might have the latest software (v2.7B) that will support all three new sensors, but only one new sensor is installed to support its OAT, e.g., v2.7B with only the AWPAG installed. With this in mind, there are Release Notes available for each software version, i.e., v2.6A (DTS1), v2.7A (DTS1 and IFW), and v2.7B (DTS1, IFW, and AWPAG).

Software v2.6A supports the DTS1 and the installation of the new single board computer processor developed by Synergy Microsystems, Inc. The algorithms for processing dewpoint temperature data for ASOS's products and messages have not changed.

The Vaisala 425 sonic anemometer, i.e., IFW, can only interface to ACU software versions beginning with v2.7A. (Software v2.6A was used as a baseline to develop v2.7A.) Like v2.6A, v2.7A can only be installed on the new processor board. Except for the implementation of the new 3-second gust sampling period, no changes were made to the ASOS wind algorithms (e.g., wind shift, variable wind direction, and peak wind remarks). Software v2.7A supports both the DTS1 and IFW sensors.

The AWPAG can only interface to ASOS using software versions beginning with v2.7B. The precipitation data processing algorithms in the ACU software are identical to those algorithms used by the HTB. In other words, only the source of the data, i.e., precipitation sensor, has changed and the algorithms used to process the data for the ASOS products and messages are unchanged. Since the AWPAG has advanced self-test maintenance firmware, new maintenance pages and system log messages are available for the electronics technician. Software v2.7B can support the DTS1, IFW, and AWPAG sensors. A new system maintenance log message was added in v2.6A to help isolate hardware problems with the new processor board.

2.1 AWPAG Sensor Interface

The AWPAG interface in software v2.7B includes: 1) Operator Interface Device (OID) functions to configure the AWPAG sensor and define it as the precipitation accumulation data source to be used in ASOS products and messages (e.g., METAR/SPECI reports); 2) System Maintenance Log (SYSLOG) messages for the sensor; 3) Maintenance functions to test and trouble shoot the sensor via the OID; and 4) Twelve-hour archive of data from the precipitation sensor not defined as the data source for ASOS products and messages.

After the AWPAG is installed and if the HTB also remains installed, the site will have the capability of defining either the HTB (FRISE TB) or the AWPAG (OTT AWPAG) as the source of the precipitation accumulation data reported by ASOS. The data from the defined precipitation

accumulation data source will be stored as part of the 12-hour archive of sensor data. If both precipitation accumulation sensors are configured on ASOS, data from the <u>undefined</u> data source will be stored in a TEST file available via the 12-hour archive OID function. (See Section 3.4.)

Currently, the plan is for the AWPAG to replace the HTB at NWS sponsored ASOS sites. Only sites participating in a precipitation bias study will have both sensors installed and configured. At most OAT sites both sensors will be installed.

2.2 Verifying Installation of Software Version 2.7B

Starting at the OID's 1-Minute Screen, use the commands REVUE-SITE-VERSN-SW to verify the installation of the v2.7B ACU application software. (See Figure 1 below.) If you are not sure you are looking at the 1-Minute Screen, press the EXIT function from the current page and that will return you to the 1-Minute Screen. If the EXIT function does not exist, but the SIGN function does, then you are looking at the 1-Minute Screen. (See Figure 2 on page 4.)

```
14:42:07 08/16/03 1942Z                                          STERLING #2
          ----------
 UNIT    BOARD    NAME            DEVICE  VERSION   DATE

 ACU     CPU A    PSOS OS         EPROM   2.5       04/19/01
         CPU B    PSOS OS         EPROM   2.5       04/19/01
         MEMORY   ACU APPLICATION EPROM   2.7B      08/15/03
         MEMORY   DCP APPLICATION EPROM   2.7B      08/15/03

 DCP-1   CPU A    BOOT            EPROM   1.90      11/03/97
         CPU B    BOOT            EPROM   1.90      11/03/97
         MEMORY   DCP APPLICATION RAM     2.7B      08/15/03

 DCP-2   CPU A    BOOT            EPROM   1.90      11/03/97
         CPU B    BOOT            EPROM   1.90      11/03/97
         MEMORY   DCP APPLICATION RAM     2.7B      08/15/03
                                                       SOFTWARE VERSIONS

                                                      PRINT

                                                      EXIT BACK
```

Figure 1: SOFTWARE VERSIONS Page (REVUE-SITE-VERSN-SW).

```
14:40:57 08/16/03 1940Z                                          STERLING #2
        -------------
  SKY         = OVC050

  VISIBILITY = 10SM                    TEMP/DEWPT   = 13.3 /-16.1 C  56 /03  F
  RVR        = RVRNO                   WIND DIR/SPD = 180/07
  PRESENT WX =                         ALTIMETER    = 30.18

  REMARKS    = RMK AO2 PWINO VISNO RY 22R


METAR KAAI 161856Z AUTO 21006KT 10SM OVC050 12/M16 A3019 RMK AO2 SLP224
T01221161 PWINO VISNO RY 22R $ FIBI



                                              ------
                                             | PRINT |
                                             |-------|-----|
                                             | REVUE |
                                             |-------|-----|
                                             | SIGN  | AUX |
        ---------
```

Figure 2: OID 1-Minute Screen

3.0 Specific Changes In Software Version 2.7B

This section will identify changes that are available to operators of the OID and to those accessing ASOS remotely via the Direct Command Mode (DCM). Operators at the OID include the UNSigned user (UNS) and the following password levels: 1) OBServer (OBS); 2) Air Traffic Controller (ATC); 3) Electronics TEChnician (TEC); and 4) SYStem Manager (SYS). The functions to be used to complete a task are provided in each section. All function command strings provided assume the operator begins from the 1-Minute Screen on the OID.   The DCM requires only a remote access code and not a password.

3.1 Configuring the AWPAG (TEC and SYS)

After the AWPAG sensor has been installed, only the electronics technician or system manager can configure the sensor on the REVUE-SITE-CONFG-SENSR page. (See Figure 3.) Using the CHANG function, move the cursor to the correct Serial Input/Output (SIO) port and enter the two-letter code of **FP** for the AWPAG. Use the EXIT or BACK function for ASOS to accept the change to the sensor configuration page.

It is important to note that only a very limited subset of ASOS sites will have both the HTB and AWPAG installed and configured. Generally, the AWPAG will replace the HTB at NWS sponsored ASOS locations. The HTB uses the two-letter code of **TB** when configured. When the HTB is replaced, the **TB** code is to be removed from the sensor configuration page.

Figure 3 is an example of a site where both the AWPAG (**FP**) and the HTB (**TB**) are configured.

```
14:41:22 08/16/03 1941Z                                      STERLING #2
┌─────────────────────────────────── ──────── ────────────────────────────┐
│                                                                          │
│         SIO #1      SIO #2       SIO #3     SIO #4      SIO #5            │
│  PORTS 2  3  4    1  2  3  4   1  3  4    1  2  3  4   1  2               │
│                                                                          │
│ DCP #1 C1 FR PW  ▓FP▓ WS TD V1  V3 ▓TB▓ DT  WI ** ** **                  │
│                                                                          │
│ DCP #2 C2 TS V2  C3 ** ** **                                             │
│                                                                          │
│ DCP #3                                                                   │
│                                                                          │
│                                                                          │
│ LOCAL SENSORS                                                            │
│                                                                          │
│ **  **   **                                                              │
│                                                    CONFIGURATION         │
│ PRESSURE SENSORS                                 ┌──────┬──────┬──────┐   │
│                                                  │PRINT │      │      │   │
│ P1  P2  P3                                       ├──────┼──────┼──────┤   │
│                                                  │ALGOR │CHANG │      │   │
│                                                  ├──────┼──────┼──────┤   │
│                                                  │EXIT  │BACK  │      │   │
│                                                  └──────┴──────┴──────┘   │
```

Figure 3: SENSOR CONFIGURATION Page (REVUE-SITE-CONFG-SENSR).

3.2 Defining the Source of the Precipitation Data (TEC and SYS)

After the AWPAG sensor has been installed and configured, only the electronics technician or system manager can define it as the source of the precipitation data to be used in all ASOS messages and products. Using the REVUE-SITE-CONFG-DEFIN page, the source of the precipitation data can be sequenced through two choices (i.e., OTT AWPAG and FRISE TB). After pressing the CHANG function, move the cursor to the PRECIP ACCUM field and use the SEQN function to sequence between OTT AWPAG and FRISE TB.   In Figure 4A below, the OTT AWPAG is the source of the precipitation data used in the ASOS messages and products, and the precipitation data from the FRISE TB will be stored on the TEST page of the 12-hour archive. (See Section 3.4.)   Comparing the DEFINE CONFIG page in Figure 4A with that of Figure 4B (prior to v2.7B), reveals that the label for the precipitation sensor changed from LIQUID PRECIP to PRECIP ACCUM, and the designation for the HTB changed from FRIEZ ASOS to FRISE TB.

After the source of the precipitation data has been defined, the report processing for the sensor can be controlled through the sensor STATUS page. Move the cursor to the PRECIP ACCUM field and use the PROC function. (See Figure 5A.)   There is no report processing control for the precipitation sensor data stored on the TEST page of the12-hour archive (i.e., in this case the HTB). These values are stored in brackets ([ ]) on the TEST page. The brackets signify the data are **NOT** used in any ASOS messages or products.

Comparing the STATUS page in Figure 5A to Figure 5B (prior to v2.7B), indicates that the precipitation sensor is now labeled PRECIP ACCUM instead of TIPPING BUCKET.

```
14:41:41 08/16/03 1941Z                                    STERLING #2
┌──────────────────────────────────────────────────────────────────┐
│                        DEFINE CONFIGURATION                        │
│                                                                    │
│   SENSORS                              HARDWARE                    │
│ CEILOMETER       POLLED              ACU MEMORY      1 MEGABYTE     │
│ VISIBILITY       BELFORT ASOS        DCP MEMORY      1 MEGABYTE     │
│ TEMP             HO83                RS_232 MODEM    UDS            │
│ DEWPOINT         DTS1                SYNCH MODEM     UDS            │
│ PRESENT WX       LEDWI               ACU/DCP COMM    PHASE II RADIO │
│ WIND             BELFORT ASOS        RT CLOCK        VIDEO CARD     │
│ PRESSURE         SETRA MODEL 470     ACU POWER SUP   ASTEC          │
│ FREEZING RAIN    PHASE II            DCP POWER SUP   R.O. ASSOC.    │
│ SNOW DEPTH       PHASE II            ACU UPS         SOLA           │
│ HAIL             PHASE II            DCP UPS         SOLA           │
│ SUNSHINE         PHASE II            GTA RADIO       MOTOROLA VT-200│
│ PRECIP ACCUM     OTT AWPAG                           DEFINE CONFIG  │
│ THUNDERSTORM     LLP TSS 924                    ┌──────┬──────┐     │
│                                                 │ PRINT │      │     │
│                                                 ├──────┼──────┤     │
│                                                 │      │ CHANG │     │
│                                                 ├──────┼──────┤     │
│                                                 │ EXIT │ BACK │     │
└──────────────────────────────────────────────────────────────────┘
```

Figure 4A: v2.7B DEFINE CONFIGURATION Page (REVUE-SITE-CONFG-DEFIN)

```
15:09:14 08/16/03 2109Z                        CHICAGO O'HARE INTERNATIONAL
┌──────────────────────────────────────────────────────────────────┐
│                        DEFINE CONFIGURATION                        │
│                                                                    │
│   SENSORS                              HARDWARE                    │
│ CEILOMETER        POLLED             ACU MEMORY      1 MEGABYTE     │
│ VISIBILITY        BELFORT ASOS       DCP MEMORY      1 MEGABYTE     │
│ TEMP/DEW POINT    HO83               RS_232 MODEM    UDS            │
│ PRESENT WX        LEDWI              SYNCH MODEM     UDS            │
│ WIND              BELFORT ASOS       ACU/DCP COMM    PHASE II RADIO │
│ PRESSURE          SETRA MODEL 470    RT CLOCK        VIDEO CARD     │
│ FREEZING RAIN     PHASE II           ACU POWER SUP   ASTEC          │
│ SNOW DEPTH        PHASE II           DCP POWER SUP   R.O. ASSOC.    │
│ HAIL              PHASE II           ACU UPS         SOLA           │
│ SUNSHINE          PHASE II           DCP UPS         SOLA           │
│ LIQUID PRECIP     FRIEZ ASOS         GTA RADIO       MOTOROLA VT-200│
│ THUNDERSTORM      LLP TSS 924                        DEFINE CONFIG  │
│                                                 ┌──────┬──────┐     │
│                                                 │ PRINT │      │     │
│                                                 ├──────┼──────┤     │
│                                                 │      │ CHANG │     │
│                                                 ├──────┼──────┤     │
│                                                 │ EXIT │ BACK │     │
└──────────────────────────────────────────────────────────────────┘
```

Figure 4B: PRE-v2.7B DEFINE CONFIGURATION Page (REVUE-SITE-CONFG-DEFIN)

```
14:42:45 08/16/03 1942Z                                    STERLING #2
     ┌──────────────────────────────────────────────────────────┐
     │    SENSOR        DCP#  SELFTEST  DATA QUALITY  AUTO/MAN  RPT PROC
     │
     │  PRECIP ACCUM      1      P          P          AUTO      ON
     │  CEILOMETER #1     1      P          P          AUTO      ON
     │  CEILOMETER #2     2      P          P          AUTO      ON
     │  CEILOMETER #3     2      F          F          AUTO      ON
     │  RVR              N/A    N/A        N/A         AUTO      OFF
     │
     │
     │
     │
     │
     │
     │                                              STATUS
     │                                      ┌───────┬───────┐
     │                                      │ PRINT │ PAGE  │
     │                                      ├───────┼───────┤
     │                                      │       │ PROC  │
     │                                      ├───────┼───────┤
     │                                      │ EXIT  │ BACK  │
     └──────────────────────────────────────────────────────────┘
```

Figure 5A: v2.7B SENSOR STATUS Page (REVUE-SENSR-STAT)

```
07:15:05 08/16/03 1315Z                       CHICAGO O'HARE INTERNATIONAL
     ┌──────────────────────────────────────────────────────────┐
     │    SENSOR        DCP#  SELFTEST  DATA QUALITY  AUTO/MAN  RPT PROC
     │
     │  TIPPING BUCKET    1     N/A         P          AUTO      ON
     │  RVR              N/A    N/A        N/A         AUTO      ON
     │
     │
     │
     │
     │
     │
     │
     │
     │                                              STATUS
     │                                      ┌───────┬───────┐
     │                                      │ PRINT │ PAGE  │
     │                                      ├───────┼───────┤
     │                                      │       │ PROC  │
     │                                      ├───────┼───────┤
     │                                      │ EXIT  │ BACK  │
     └──────────────────────────────────────────────────────────┘
```

Figure 5B: PRE-v2.7B SENSOR STATUS Page (REVUE-SENSR-STAT)

3.3 Current Sensor Data (UNS, OBS, TEC, SYS)

The ATC password level does not have access to these data. The current sensor data being
used by the algorithms are displayed on the **CURRENT** sensor data pages. These pages have
changed slightly with the implementation of software v2.7B.   (See Figures 6A and 6B.) Since the
AWPAG reports the water equivalent of freezing and frozen precipitation as a precipitation
amount, the WATER EQUIVALENT (HOUR) amount was removed from the bottom of the

CURRENT sensor data page; it was considered redundant. Therefore only the hourly PRECIPITATION AMOUNT and CURRENT SNOW DEPTH fields are provided.   If the HTB is defined as the source of the precipitation data this data page does not change. In the past, the HTB was a very poor source of liquid water equivalent measurements and all precipitation amounts were recorded as hourly amounts. In other words, the WATER EQUIVALENT (HOUR) entry was not used and it was redundant, based on ASOS's capabilities, so it was removed from the page.

```
14:43:45 08/16/03 1943Z                                          STERLING #2
       -----------------------------------------------------------
       |                  1-MINUTE CURRENT SENSOR DATA            |
       |                                                          |
       |   UTC  VIS1  D/N1  VIS2  D/N2  VIS3  D/N3  TEMP DEWPT  PEAK WIND   RVR    |
       |                                                          |
       |   1934 10.00  D      M    D   10.00  D     56    3      224   9     M     |
       |   1935 10.00  D      M    D   10.00  D     56    3      212   8     M     |
       |   1936 10.00  D      M    D   10.00  D     56    3      210   8     M     |
       |   1937 10.00  D      M    D   10.00  D     56    3      197   9     M     |
       |   1938 10.00  D      M    D   10.00  D     56    3      186   7     M     |
       |   1939 10.00  D      M    D   10.00  D     56    3      189   8     M     |
       |   1940 10.00  D      M    D   10.00  D     55    3      174   8     M     |
       |   1941 10.00  D      M    D   10.00  D     55    3      170   7     M     |
       |   1942 10.00  D      M    D   10.00  D     55    3      182   6     M     |
       |   1943 10.00  D      M    D   10.00  D     53    3      172   5     M     |
       |                                                          CURRENT         |
       |                                                        --------------    |
       | PRECIPITATION AMOUNT (HOUR):    0.00 IN                 |PRINT PAGE|      |
       | CURRENT SNOW DEPTH:              M   IN                 |---------------  |
       |                                                        |          |UPDAT |
       |                                                        |----------------  |
       |                                                        |EXIT  BACK|       |
       -----------------------------------------------------------
```

Figure 6A: v2.7B CURRENT SENSOR DATA Page (REVUE-SENSR-DATA)

```
15:10:27 08/16/03 2110Z                                  CHICAGO O'HARE INTERNATIONAL
       -----------------------------------------------------------
       |                  1-MINUTE CURRENT SENSOR DATA            |
       |                                                          |
       |   UTC  VIS1  D/N1  VIS2  D/N2  VIS3  D/N3  TEMP DEWPT  5SEC WIND   RVR    |
       |                                                          |
       |   2100  0.47  D               0.42  D     29    27     34    6    14R40  |
       |   2101  0.50  D               0.44  D     29    27     49    3    14R40  |
       |   2102  0.48  D               0.43  D     29    27     56    6    14R40  |
       |   2103  0.49  D               0.45  D     29    27     36    3    14R40  |
       |   2104  0.47  D               0.46  D     29    27     38    2    14R40  |
       |   2105  0.47  D               0.44  D     29    27     37    1    14R40  |
       |   2106  0.46  D               0.43  D     29    26     53    5    14R40  |
       |   2107  0.46  D               0.43  D     29    27     37    3    14R40  |
       |   2108  0.43  D               0.41  D     29    27     48    2    14R35  |
       |   2109  0.40  D               0.38  D     29    27     32    3    14R35  |
       |                                                          CURRENT         |
       | PRECIPITATION AMOUNT (HOUR):    0.02 IN                 --------------    |
       | WATER EQUIVALENT (HOUR):         M   IN                 |PRINT PAGE|      |
       | CURRENT SNOW DEPTH:              M   IN                 |---------------  |
       |                                                        |          |UPDAT |
       |                                                        |----------------  |
       |                                                        |EXIT  BACK|       |
       -----------------------------------------------------------
```

Figure 6B: PRE-v2.7B - CURRENT SENSOR DATA Page (REVUE-SENSR-DATA)

3.4 <u>Twelve-Hour Archive Data</u> (UNS, OBS, TEC, SYS)

    The ATC password level does not have access the 12-hour archive data. By using the
REVUE-SENSR-(12-HR)-PAGE functions from the 1-Minute Screen, the one minute observed
precipitation amounts from the defined sensor, in our case AWPAG, will be displayed. (See
Figure 7.) This page has not changed from previous software versions. By viewing only this
page of data it is not possible to determine if the defined precipitation sensor is the AWPAG or
the HTB.   In Figure 7 the HTB was the primary precipitation accumulation sensor until 1714
UTC (Universal Time Coordinated) when the AWPAG was then defined as the primary sensor.
During the minute of 1715 UTC the report processing for the AWPAG was turned ON. Note
the brackets around the PRECIP data for 1714 and 1715 UTC.

```
12:17:07 08/16/03 1717Z                                       STERLING #2
-----------------------------------------------------------
 UTC  WX   TS   PRECIP SUN   SNOW    ZR     PRESS1   PRESS2   PRESS3   TEMP DEWPT
1705  M  0000    0.00                39993   29.788   29.781   29.780    40   23
1706  M  0000    0.00                39993   29.788   29.781   29.780    40   23
1707  M  0000    0.00                39993   29.788   29.781   29.780    40   23
1708  M  0000    0.00                39993   29.788   29.782   29.781    39   23
1709  M  0000    0.00                39993   29.789   29.782   29.781    39   23
1710  M  0000    0.00                39993   29.788   29.782   29.781    39   23
1711  M  0000    0.00                39993   29.788   29.782   29.781    39   23
1712  M  0000    0.00                39993   29.788   29.781   29.780    39   23
1713  M  0000    0.00                39993   29.787   29.780   29.779    39   23
1714  M  0000  [ 0.00]               39993   29.786   29.779   29.778    39   23
1715  M  0000  [ 0.00]               39993   29.785   29.779   29.778    40   23
1716  M  0000    0.00                39993   29.785   29.779   29.778    41   23

                                               12HR ARCHIVE

                                            PRINT PAGE|  PREV

                                                  TIME|  TEST

                                            EXIT BACK  NEXT
```

Figure 7: v2.7B 12HR ARCHIVE Page (REVUE-SENSR-(12-HR)-PAGE)

    Use the **TEST** function on this keypad to access the precipitation data from the sensor **NOT**
defined to provide data for the ASOS products and messages. All data on this page will be stored
in brackets (i.e., [ ]) to signify they are not used to report weather conditions occurring at the site.
(See Figure 8A.)   With the development of v2.7B, two new columns were added to this page.
The accumulated precipitation catch (ACC PRECIP) and the total amount in the bucket of the
gauge (TOT GAGE) are displayed.

    If the AWPAG is the TEST sensor, determine the one minute precipitation total simply
subtract the current minute's total from the previous minute's total in the ACC PRECIP column.
The amounts in the TOT GAGE can be used to monitor when the AWPAG bucket will need to be
emptied. If the HTB is the TEST sensor, then the amount of precipitation that fell during the
minute is just the amount displayed in the ACC PRECIP field and no subtraction between values
is needed. Also note that if the HTB is the TEST sensor, the entry under the TOT GAGE column
will be **N/A**. This is because the HTB does not require emptying of a storage bucket.

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In Figure 8A, prior to 1708 UTC the AWPAG was defined as the primary sensor. During the minute of 1708 UTC the HTB was the primary sensor. Later, during the minute of 1714 UTC, the AWPAG was defined as the primary sensor.

```
12:17:26 08/16/03 1717Z            *** LOCAL ***            STERLING #2
┌─────────────────────────────────────────────────────────────────────┐
│UTC  DEWPT WIND DIR  WIND SPEED  PEAK WIND DIR  PEAK WIND ACC PRECIP  TOT GAGE
│1705 [ 24]                                                [ 0.00]  [ N/A ]
│1706 [ 24]                                                [ 0.00]  [ N/A ]
│1707 [ 24]                                                [ 0.00]  [ N/A ]
│1708 [ 24]                                                [ 0.00]  [13.88]
│1709 [ 24]                                                [ 0.00]  [13.88]
│1710 [ 23]                                                [ 0.00]  [13.88]
│1711 [ 23]                                                [ 0.00]  [13.88]
│1712 [ 23]                                                [ 0.00]  [13.88]
│1713 [ 23]                                                [ 0.00]  [13.88]
│1714 [ 23]                                                [ 0.00]  [ N/A ]
│1715 [ 23]                                                [ 0.00]  [ N/A ]
│1716 [ 23]                                                [ 0.00]  [ N/A ]
│
│                                                   12HR TEST SENSOR
│                                                  ┌─────────┬────────┐
│                                                  │ PRINT   │  PREV  │
│                                                  ├─────────┴────────┤
│                                                  │       TIME       │
│                                                  ├─────┬──────┬─────┤
│                                                  │ EXIT  BACK  NEXT │
```

Figure 8A: v2.7B 12HR ARCHIVE TEST SENSOR Page
(REVUE-SENSR-(12-HR)-TEST)

```
07:36:42 08/16/03 1236Z                                     STERLING #2
┌─────────────────────────────────────────────────────────────────────┐
│   UTC  DEWPT  WIND DIR  WIND SPEED   WIND DIR @ PEAK SPD  PEAK WIND
│  1224 [ 25]   [272]      [  8]          [261]             [  9]
│  1225 [ 25]   [267]      [  8]          [265]             [  9]
│  1226 [ 25]   [274]      [  7]          [288]             [  9]
│  1227 [ 25]   [275]      [  7]          [267]             [ 10]
│  1228 [ 25]   [272]      [  9]          [274]             [ 11]
│  1229 [ 25]   [266]      [  9]          [259]             [ 11]
│  1230 [ 25]   [264]      [  8]          [264]             [ 10]
│  1231 [ 25]   [267]      [  9]          [272]             [ 11]
│  1232 [ 25]   [269]      [  9]          [282]             [ 11]
│  1233 [ 25]   [276]      [  8]          [269]             [  9]
│  1234 [ 25]   [275]      [  9]          [278]             [ 10]
│  1235 [ 25]   [269]      [  9]          [274]             [ 11]
│
│                                                   12HR TEST SENSOR
│                                                  ┌─────────┬────────┐
│                                                  │ PRINT   │  PREV  │
│                                                  ├─────────┴────────┤
│                                                  │       TIME       │
│                                                  ├─────┬──────┬─────┤
│                                                  │ EXIT  BACK  NEXT │
```

Figure 8B: PRE-v2.7B - 12HR ARCHIVE TEST SENSOR Page
(REVUE-SENSR-(12-HR)-TEST)

10

3.5 System Maintenance Log (SYSLOG) Messages (UNS, OBS, TEC, SYS)

The ATC password level can not view messages in the SYSLOG. Press REVUE-SYSLG to enter the system maintenance log. ASOS automatically monitors the precipitation sensor being used to provide data in the messages and products, as well as the TEST sensor. The TEST sensor is not monitored as closely as the other sensors, and if a maintenance action is required for this sensor a maintenance indicator sign ($) is **NOT** appended to the METAR/SPECI reports.

In order for ASOS to report the maintenance status of the AWPAG sensor, the following SYSLOG messages are used.

SYSLOG Messages for the AWPAG:

360 AWPAG Sensor Power Command Off Remained On
375 AWPAG Sensor Power Command On Remained Off
388 AWPAG Sensor Configured

406 AWPAG Sensor Deconfigured

1861 AWPAG Is The Primary Precipitation Accumulation Sensor
1862 Official Precipitation Accumulation Sensor Response Timeout /
        Test Precipitation Accumulation Sensor Response Timeout
1863 AWPAG Sensor Status Failure
1864 AWPAG Sensor Pipehouse Failure
1865 AWPAG Sensor Bucket Failure
1866 AWPAG Sensor Balance System Failure
1867 AWPAG Sensor LogoSens Board Failure
1868 AWPAG Sensor Ring Heating Control Failure
1869 AWPAG Sensor Power Supply Failure

1870 AWPAG Sensor Internal Heating Failure
1871 Official Precipitation Accumulation Sensor Data Quality Check Error /
        Test Precipitation Accumulation Sensor Data Quality Check Error
1874 AWPAG Sensor Is Operational
1875 AWPAG Sensor Is Inoperational
1876 PRACC Command Is Issued To AWPAG Sensor
1877 Accumulation In AWPAG Sensor Exceeded The Limit
1878 Tipping Bucket Is The Primary Precipitation Accumulation Sensor
1879 One Minute Precip Is Invalid

1880 <last valid date/time> to <current date/time> recovered <recovered precipitation amount>
        inches

1881 Invalid Response received from AWPAG sensor for PRACC command
1882 AWPAG Sensor Ring Heating Selftest Failure

Hardware SYSLOG Message for Processor Errors

The replacement ASOS processor board (Synergy Microsystems model VGMD) executes comprehensive built-in test diagnostic routines during power-up. During headquarters activities to prepare for System Acceptance Testing, it was observed that these diagnostic routines were reporting transient anomalies, however the reports were unavailable to ASOS because they were only displayed on an external debug terminal. The ASOS ACU software has been modified to log any such built-in test diagnostic reports in the SYSLOG. In general, these will not be hard failures, but rather "transient" failures or conditions which may not impact processor execution, but which will be recorded for future investigation.

The SYSLOG message will indicate the specific hardware element which exhibits the anomaly, and if available other conditional information (such as interrupt level). These messages are not intended to be decoded by the ASOS technician, but will be of use to headquarters personnel during investigation of anomalies. Only one SYSLOG message is defined and it is supplemented by additional messages as listed below:

2164 CPU HARDWARE ERROR:

- Bad MPIC vendor and Device
- ACT bit in MPIC constantly set
- Bad IRQ line
- Bad interrupt from device
- SYSFAIL condition detected
- VME Address Error detected
- Bad VME Interrupt Vector from device status %x vector %x
- ETHERNET BUS ERROR
- ETHERNET HEARTBEAT ERROR
- ETH_BUS_ERROR
- ETHERNET CRC ERROR
- ETHERNET OVERLOW
- Rx Illegal Instruction
- Rx PCI Bus Error
- Rx PCI Parity Error
- Tx Illegal Instruction
- Tx PCI Bus Error
- Tx PCI Parity Error
- PCI PARITY ERROR for Bus %x, Device %x Function %x
- PCI SYSTEM ERROR for Bus %x, Device %x Function %x

- SERIAL FRAMING ERROR
- SERIAL OVERRUN ERROR
- SERIAL PARITY ERROR
- MK48_BAD_CALIBRATION
- MK48_BAD_HOURS
- MK48_BAD_MINUTES
- MK48_BAD_SECONDS
- MK48_BAD_DAY
- MK48_BAD_YEAR
- MK48_BAD_DATE
- MK48_BAD_MONTH

An example of the message is shown below.

```
08/16/03 03:14   *SY 2164   CPU HARDWARE ERROR: SYN_PIC.C
UNIVERSEINT4: BAD VME INTERRUPT VECTOR FROM DEVICE STATUS  4004
VECTOR  FF
```

3.6   Maintenance Page for AWPAG (TEC and SYS)

A maintenance page has been provided to perform maintenance actions on the AWPAG. This page is accessed through the MAINT function from the 1-Minute Screen. From the Maintenance Page (Figure 9), use the SEL function to select the appropriate Data Collection Package (DCP) or ACU (Figure 10), and then select **AWPAG** (Figure 11).

```
12:17:49 08/16/03 1717Z              *** LOCAL ***              STERLING #2
┌─────────────────────────────────────────────────────────────────────────┐
│                                                                           │
│                                                                           │
│  ACU   P            DCP #1  F       ACU/DCP COMMS  F       TREND      PROC │
│                                                                           │
│                     DCP #2  F                             ADAS SUMMARY    │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                                           │
│                                                           MAINTENANCE     │
│                                                        ┌──────┬─────┬─────┐│
│                                                        │PRINT │CLEAR│PREV ││
│                                                        ├──────┼─────┼─────┤│
│                                                        │SEL   │ACT  │     ││
│                                                        ├──────┼─────┼─────┤│
│                                                        │EXIT  │     │NEXT ││
└────────────────────────────────────────────────────── └──────┴─────┴─────┘
```
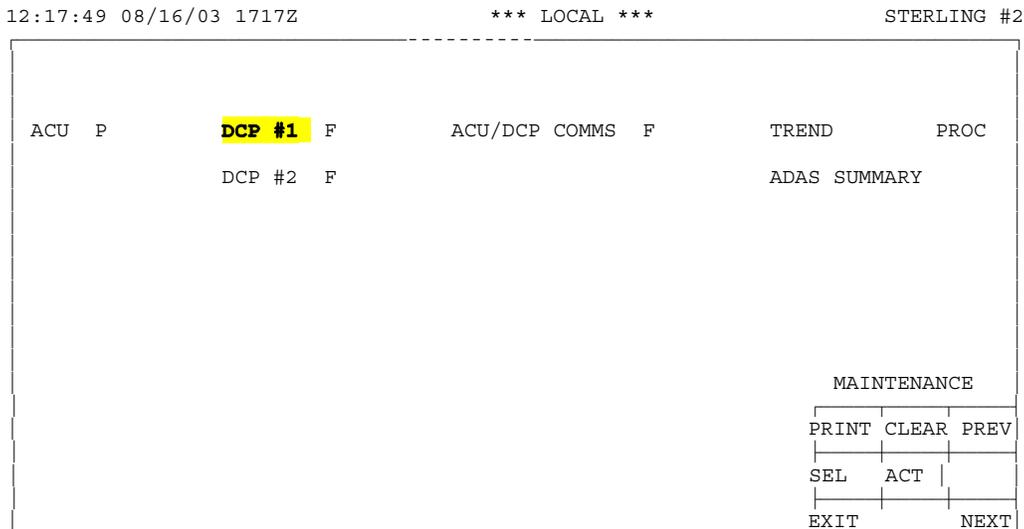
Figure 9: MAINTENANCE Page (MAINT)

```
12:18:32 08/16/03 1718Z                                      STERLING #2
       ┌────────────────────── ---------- ──────────────────────────┐
       │    SENSOR GROUP:                      HARDWARE:             │
       │  CEILOMETER #1         P                                    │
       │  FREEZING RAIN         P        VME            P            │
       │  PRESENT WEATHER       F                                    │
       │  AWPAG                 P        DCP POWER      P            │
       │  WIND SPEED/DIR        P                                    │
       │  1088/H083             P        DCP UPS#1      P            │
       │  VISIBILITY #1         P                                    │
       │  VISIBILITY #3         P                                    │
       │  DTS1                  P                                    │
       │                                                             │
       │                                                             │
       │                                                             │
       │                                              REMOTE DCP#1   │
       │                                          ┌─────┬─────┬─────┐│
       │                                          │PRINT│CLEAR│PREV ││
       │                                          ├─────┼─────┼─────┤│
       │                                          │SEL  │     │     ││
       │                                          ├─────┼─────┼─────┤│
       │                                          │EXIT │BACK │NEXT ││
       └─────────────────────────────────────────┴─────┴─────┴─────┘
```

Figure 10: ACU / Remote DCP STATUS Page (MAINT-DCP#1)1

```
12:18:45 08/16/03 1718Z                                      STERLING #2
       ┌────────────────────── ---------- ──────────────────────────┐
       │                                                             │
       │                                                             │
       │  SENSOR STATUS            P         DATA QUALITY        P   │
       │  PIPEHOUSE SWITCH STATUS  P         REPORT PROCESS      Y   │
       │  BUCKET STATUS            P         SENSOR RESPONSE     P   │
       │  BALANCE SYSTEM STATUS    P                                 │
       │  LOGOSENS STATUS          P         POWER STATUS        P   │
       │  RING HEAT CONTROL STATUS P         POWER CONTROL       ON  │
       │  RING HEAT STATUS         P                                 │
       │  POWER SUPPLY STATUS      P                                 │
       │  INTERNAL HEATING STATUS  P         AMOUNT IN BUCKET    13.88│
       │  POWER SUPPLY VOLTAGE     11.5      ACCUMULATED PRECIP  0.11 │
       │  AMBIENT TEMPERATURE      037.0                             │
       │  ENCLOSURE TEMPERATURE    043.3               AWPAG         │
       │  HEATERS                  ON                                │
       │                                      ┌──────┬──────┬──────┐ │
       │                                      │PRINT │CLEAR │      │ │
       │                                      ├──────┼──────┼──────┤ │
       │                                      │TEST  │      │POWER │ │
       │  LAST BUCKET RESET                   ├──────┼──────┼──────┤ │
       │                                      │EXIT  │BACK  │PRACC │ │
       └──────────────────────────────────────┴──────┴──────┴──────┘
```

Figure 11: AWPAG SENSOR MAINTENANCE Page (MAINT-DCP#1-AWPAG)

Please note that a maintenance page is ONLY provided for the precipitation sensor defined as the data source. In this case ONLY the AWPAG has a maintenance page. IF the HTB is installed and configured, but not defined as the precipitation data source, then a maintenance page for the HTB will <u>NOT</u> be available.

3.7   Direct Command Mode (Remote Access)

The precipitation data displayed on page 2 of the 12-hour archive, data in the TEST file of the 12-hour archive, and data stored in the new AWPAG file can all be downloaded via the Direct

Command Mode (DCM). In v2.7B a new DCM command has been developed for downloading AWPAG data regardless if it is defined as the primary sensor. The AWPAG command will retrieve the STATUS (i.e., pass or fail), ACC PRECIP, and TOT GAGE amounts. ASOS will store the previous 12 hours of the data to support all three of these DCM commands. (See Figure 12 below. This figure has four parts.) The DCM commands to download these data have the following syntax:

12HR2 hhmm$_i$ hhmm$_f$ - 12-Hour Archive Data Used in Messages / Products

12TEST hhmm$_i$ hhmm$_f$ - Data Stored in the TEST file of the 12-Hour Archive

AWPAG hhmm$_i$ hhmm$_f$ - Data Stored in the AWPAG file for 12 Hours

Where: **hhmm$_i$** - begin time and **hhmm$_f$** - end time

NOTE: Placing a "Z" after the time will retrieve data based on UTC. If a "Z" is not entered, ASOS assumes Local Standard Time (LST).

In Figure 12, the AWPAG is defined as the precipitation sensor and the HTB is storing its data in the 12TEST file.

Figure 12 - I. Page 2 of the 12-Hour Archive. AWPAG precipitation amounts are stored under the PRECIP column.

```
CMD>12HR2 1910 1920Z

* BRACKETS [] INDICATE QUESTIONABLE SENSOR DATA, REPORT PROCESSING OFF *

LISTING 12HR PAGE #2 FROM: 08/16/2003 19:10 THRU 08/16/2003 19:20

 UTC  WX    TS    PRECIP SUN    SNOW     ZR     PRESS1  PRESS2  PRESS3  TEMP DEWPT
1910  M    0000    0.00                 39990   29.785  29.778  29.777   37   27
1911  M    0000    0.00                 39990   29.785  29.778  29.777   38   27
1912  M    0000    0.00                 39991   29.785  29.778  29.777   38   27
1913  M    0000    0.00                 39991   29.785  29.779  29.778   38   27
1914  M    0000    0.00                 39991   29.786  29.780  29.779   39   27
1915  M    0000    0.01                 39991   29.787  29.780  29.779   38   27
1916  M    0000    0.00                 39991   29.787  29.781  29.780   38   27
1917  M    0000    0.00                 39991   29.788  29.781  29.780   38   26
1918  M    0000    0.00                 39991   29.789  29.783  29.782   39   27
1919  M    0000    0.00                 39990   29.790  29.784  29.783   39   27
1920  M    0000    0.00                 39990   29.790  29.784  29.783   38   27
12HR LISTING COMPLETE, 11 ENTRY(S) LISTED.

CMD>
```

Figure 12 - II. The 12TEST file contains data from the HTB.

CMD>12TEST 1910Z 1920

LISTING 12HR TEST PAGE FROM: 08/16/2003 19:10 THRU 08/16/2003 19:20

UTC	DEWPT	WIND DIR	WIND SPEED	PEAK WIND DIR	PEAK WIND	ACC PRECIP	TOT GAGE
1910	[25]					[0.00]	[N/A]
1911	[26]					[0.00]	[N/A]
1912	[26]					[0.00]	[N/A]
1913	[26]					[0.00]	[N/A]
1914	[26]					[0.00]	[N/A]
1915	[26]					[0.00]	[N/A]
1916	[26]					[0.00]	[N/A]
1917	[26]					[0.00]	[N/A]
1918	[26]					[0.00]	[N/A]
1919	[26]					[0.00]	[N/A]
1920	[26]					[0.00]	[N/A]

12HR TEST LISTING COMPLETE, 11 ENTRY(S) LISTED.

CMD>

Figure 12 - III. Since the AWPAG is defined as the precipitation sensor, if the AWPAG file did not exist then the ACC PRECIP and TOT GAGE data would be lost. These data are available for 12 hours.

CMD>AWPAG 1910Z 1920

* BRACKETS [] INDICATE QUESTIONABLE SENSOR DATA, REPORT PROCESSING OFF *

LISTING AWPAG DATA FROM: 08/16/2003 19:10 THRU 08/16/2003 19:20

UTC	STATUS	ACCUM PRECIP	TOTAL BUCKET
1910	P	00.11	13.88
1911	P	00.11	13.88
1912	P	00.11	13.88
1913	P	00.11	13.88
1914	P	00.11	13.88
1915	P	00.12	13.88
1916	P	00.12	13.88
1917	P	00.12	13.88
1918	P	00.12	13.88
1919	P	00.12	13.88
1920	P	00.12	13.88

12HR AWPAG LISTING COMPLETE, 11 ENTRY(S) LISTED.

Figure 12 - IV. The 5-minute observations below show the AWPAG data being used to generate observations.

CMD>5MIN 0129 1910Z 0129 1920Z
LISTING 5MINS FROM: 08/16/2003 14:10 THRU 08/16/2003 14:20
08/16/03 14:10:31 5-MIN KAAI 161910Z AUTO 02003KT 8SM SCT028 OVC039 03/M03
 A3009 -50 64 -1400 020/03 RMK AO2 PWINO VISNO RY 22R $
08/16/03 14:15:31 5-MIN KAAI 161915Z AUTO 02004KT 8SM BKN030 OVC039 03/M03
 A3009 -50 64 -1400 030/04 RMK AO2 P0001 PWINO VISNO RY 22R $
08/16/03 14:20:31 5-MIN KAAI 161920Z AUTO 36004KT 9SM BKN028 OVC039 03/M03
 A3009 -50 64 -1400 010/04 RMK AO2 P0001 PWINO VISNO RY 22R $
5MIN LISTING COMPLETE, 3 5MIN(S) LISTED.

CMD>

Figure 12: 12-HR Archive, 12TEST, AWPAG Data, & 5-Minute Observations Downloaded via DCM

4.0 Summary

    Implementation of the new AWPAG precipitation sensor is expected to improve the accuracy and reliability of ASOS precipitation reported during freezing and frozen precipitation events. Current plans call for the AWPAG to be deployed at NWS sponsored ASOS sites. The HTB rain gauge is expected to remain at FAA sponsored sites, as well as sites participating in any future bias studies.

    Compared to the HTB, the AWPAG is an intelligent sensor with extensive maintenance diagnostic capabilities. The meteorological algorithms processing the precipitation data received from the sensors have not changed. The only change is the sensor providing the precipitation data.

     The OID interfaces for the UNS and both the ATC and OBS password levels have not changed. Procedures required to perform surface observing duties (i.e., editing and augmenting of data, or the controlling of the report processing functions) have not changed. Capabilities for supporting the AWPAG have been added to the TEC and SYS password levels. Sites with both AWPAG and HTB installed and configured will store data from each sensor. Data from the sensor <u>NOT</u> being used in the ASOS products and messages will be available from the DCM (12TEST command), or from the OID's 12-hour archive via the TEST function. Data from the sensor being used in ASOS's products and messages will be stored on page 2 of the 12-hour archive. The data from the AWPAG will be available via the DCM by using the AWPAG command. It will be available regardless if the data are being used operationally.

    Implementation of the AWPAG will require installation of ASOS software v2.7B. This software must be installed on the new single board computer processing board. Software v2.7B will also support installations of the IFW and DTS1 sensors.

ACRONYMS

ACU	-	Acquisition Control Unit
AOMC	-	ASOS Operations and Monitoring Center
ASOS	-	Automated Surface Observing System
ATC	-	OID Air Traffic Controller Password Level
AWPAG	-	All Weather Precipitation Accumulation Gauge
DCM	-	Direct Command Mode
DCP	-	Data Collection Package
DTS1	-	Vaisala DTS1 Dewpoint Temperature Sensor
HTB	-	Heated Tipping Bucket Rain Gauge (FRIZE TB)
IFW	-	Ice Free Wind Sensor (Vaisala 425)
LST	-	Local Standard Time
NWS	-	National Weather Service
OAT	-	Operational Acceptance Test
OBS	-	OID Observer Password Level
OID	-	Operator Interface Device
SIO	-	Serial Input/Output
SYS	-	OID System Manager Password Level
SYSLOG	-	System Maintenance Log
TEC	-	OID Electronics Technician Password Level
UNS	-	OID Unsigned User Level
UTC	-	Universal Time Coordinated

Appendix A

AWPAG Mechanical Drawing

70.010.437.3.1

Ø36in (Ø915mm)
Lochkreis Befestigungsbohrungen

M8x16 DIN933-A2-70
0.000933.308 (16x)

M8 DIN934-A2-70 Prec.85
0.000934.115 (16x)

M8x16 DIN464-A2 matt
0.000464.201 (4x)

M12 DIN934-A2-70
0.000934.112 (4x)
zuzüglich 4x (von Ankerstange)

B13 DIN9021-A2
0.009021.103 (16x)

Ankerstange M12x220-A4-70
99.000.074.9.5 (4x)

Verbundanker-Patrone
99.000.075.9.5 (4x)

Kleinteile in Minigripbeutel (27.250.042.9.5) beiderzugeben

M8 DIN934-A2-70 Prec.85
0.000934.115 (15x)

M8x16 DIN933-A2-70
0.000933.308 (15x)

70.010.495.3.1 (4x)

70.010.496.3.1 (5x)

70.010.438.3.1 (16x)

70.010.482.3.1 (16x)

M8 DIN934-A2-70 Prec.85
0.000934.115 (16x)

M8x16 DIN933-A2-70
0.000933.308 (16x)

70.010.494.3.1

Ø39.6in (Ø1006mm)

±1.5in (height adjustable)

57.5in (1460.5mm)

Maße ohne
Toleranzangabe
DIN 7168 - mT

Paßmaß
Abmaß 1
Abmaß 2

Index
a
—

Anzahl
Änderungsmitteilungs-Nr.
neue Zeichnung 45.828.04.02

Tag
05.12.01

Name
Singer

gez.
gepr.
Norm

HYDROMETRIE

Werkstoff: Rohteil-Nr.:

Zeichnungs-Nr.:
70.010.077.3.21

Benennung:
Windschutz
komplett demontierbar
NOAA

Maßstab:
1 : 8

Blatt: 1
von 1

Ersatz für:
Ersetzt durch:

Appendix A - 1

Appendix B

Functional Interface Description
Data Communication RS232-C Protocol
AWPAG for ASOS

Proposal Version 3.5 October 29, 2002

The AWPAG RS-232 communication Interface is described below.
Communication between the ASOS and the AWPAG shall be via an RS-232 serial port implemented through a fiber optic modem utilizing separate send and receive lines. The command and response messages shall use ASCII characters. Byte structure shall be:

> 1 start bit
> 8 data bits
> 1 stop bit
> No parity
> 2400 bits per second (programable to 9600)
> Half Duplex
> Serial Asynchronous

Message responses, consisting of fixed-length messages described herein, are transmitted to the ASOS following receipt of a POLL command. Each message contains a checksum parameter that permits verification that the entire message was received by the ASOS and that the message was not corrupted during transmission. The methodology for calculating the checksum parameter is described following the description of message responses. The following list describes the available ASOS POLL commands:

POLL Request command list

P1	Precipitation Accumulation Message
PD	Sensor Diagnostic Results Message
PRACC	Reset of accumulated precipitation

The AWPAG will provide a response message within 250ms following received POLL command, excluding PM, PT and PX command.
Response time for PM/PT command is 270ms at 2400 baud.

P1 Command:

In response to the **P1** command the AWPAG will provide a **P1** response reporting measurement data and one Pass/Fail flag. An ASOS POLL command requesting measurement and diagnostic data normally occurs each minute. Important measured data and status information are included in the response message. The AWPAG measurement operation and associated calculations begins at the start of each minute period and requires approximately 6 seconds to complete. The **P1** response message contains calculated general status of the last full minute interval, accumulated precipitation and the total of the bucket.

A **P1** POLL command received after the 15th second of a full minute interval will result in an AWPAG response containing data representing the previous full minute calculation. Measurement data and one "<u>Pass/Fail flag</u>" are both included in the message to get diagnostic information if measurement is pass, fail or restarted. If a power off period is detected and precipitation appears while power off, the AWPAG will calculate this missing precipitation within the first few minutes after restart. Any precipitation output which is post calculated from a power off period will be marked with a <u>R-flag</u>.

Diagnostic data belongs to the accumulated precipitation of the same interval.

The "<u>accumulated precipitation</u>" value represent the filtered amount of precipitation since the receipt of the last accumulated precipitation reset command (PRACC). The resolution is 0.01inch. The reported accumulated precipitation will not be rounded, but be truncated. This satisfies the requirement that the AWPAG not report 0.01 inch of accumulation unless such accumulation was actually received. E.g. with a resolution of 0.01 inch, 0.0099 inch would be reported as 0.00 until such time as the actual catch was 0.01.

Should a power failure be detected, the AWPAG will write the "accumulated precipitation" and the filtered total of the bucket parameter to non-volatile memory. The "accumulated precipitation" will be available for the next data transmission once power is returned and the first measurement will be done.

After power up a <u>warm up procedure</u> of 95sec is starting. Within this time of 95sec the "total of the bucket" will be placed to 99.99.

The "<u>total of the bucket</u>" represent the raw value of total amount of water in the bucket at the moment. It's not a filtered value. The resolution is 0.01inch.

The **P1** message provided in response to a received POLL command **P1 <CR>** (Request Measurement and Pass/Fail flag) is described below:

Bytes	Name	Unit	Message
1	Start of transmission		STX
2-3	Sensor ID, Message ID		P1
4	Pass/Fail flag		P/F/R
5-9	Accumulated precipitation	inch	xx.xx
10-14	Total of the bucket	inch	xx.xx
15-16	Checksum		xx
17	End of transmission		ETX
18	Carriage return		CR
19	Line feed		LF

Notes:
For all measurement values the following characters are allowed:
1, 2, 3, 4, 5, 6, 7, 8, 9, 0, ".", ",", ":", "-"

All other character strings are HEX-ASCII.
Accumulated precipitation overflow at 99.99 inch
If an error is detected in any measurement value or a warm up procedure is running, each figure of the failed value will be set to 9 (e.g. 99.99). This failure appears if a POLL is received within the first 6 seconds after power up.

PD Command:

In response to the **PD** command the AWPAG will provide a **PD** response reporting diagnostic data. If a 'Fail' flag is received following a P1 command, a PD command has to be send to the AWPAG for checking the diagnostic data.
Supply voltage is added to the response string for checking power supply. This value is filtered, transients don't interfere measurements.
The **PD** message provided in response to a received POLL command **PD <CR>** (Request Diagnostic data as Pass/Fail flags) is described below:

Bytes	Name	Unit	Message
1	Start of transmission		STX
2-3	Sensor ID, Message ID		PD
4	Pipehouse switch Pass/Fail flag		P/F
5	Bucket Pass/Fail flag		P/F
6	Balance system Pass/Fail flag		P/F
7	LogoSens board Pass/Fail flag		P/F
8	Ring heating control Pass/Fail flag		P/F
9	Ring heating selftest Pass/Fail flag		P/F
10	Power Supply Pass/Fail flag		P/F
11	Internal heating Pass/Fail flag		P/F
12-15	Supply voltage	V	xx.x
16-20	Ambient temperature	$^\circ$F	-xx.x
21-25	Internal temperature	$^\circ$F	-xx.x
26	Heating On/Off status		Y/N
27-28	Checksum		xx
29	End of transmission		ETX
30	Carriage return		CR
31	Line feed		LF

Note:
If an error is detected in any measurement, each figure of the failed value will be set to 9 (e.g. 99.9). This failure appears if a POLL is received within the first 6 seconds after power up.

PRACC Command:

The **PRACC** command is used to initiate a reset of the accumulated precipitation parameter.

The **PRACC** message provided in response to a received POLL command **PRACC <CR>** (Request Reset of Accumulated Precipitation) is described below:

Bytes	Name	Message
1	Start of transmission	STX
2-3	Sensor ID, Message ID	PA
4	Space	
5-6	Checksum	xx
7	End of transmission	ETX
8	Carriage return	CR
9	Line feed	LF

The accumulated precipitation parameter will be reset to zero following transmission of the response.

Appendix C

ASOS Algorithm Processing for Frozen Precipitation Sensor

Process All-Weather Precipitation Accumulation Gauge Data

      Timing =   Once each minute after 6.8.2.1.1

      Input =   Current accumulated precipitation reading, previous accumulated precipitation reading, total precipitation reading, present weather report, sensor status, previous sensor status, outage flag, precipitation intensity counter, hourly precipitation amount, 5-minute average ambient temperature values

(a)   Write the current P1 response to the DCM file for 12 hours. Write the current accumulated precipitation reading and the total precipitation reading to the maintenance page.

(b)   If the current sensor status in the P1 response is "F":

    II. If the current response to the PD command indicates a heater controller error (byte 8) or ring heater error (byte 9) and all other diagnostics are set to "P", determine the AWPAG temperature as follows:

        <u>a</u>   If the observer has edited the temperature, set the AWPAG temperature to the edited value. Otherwise, find the average of all the values of the 5-minute average ambient temperatures in the last 15 minutes that are not set to "missing". If less than 5 temperature values in the last 15 minutes are set to "missing", set the AWPAG temperature to the average of the non-missing temperature values in the last 15 minutes. Otherwise, set the AWPAG temperature to missing. ((Similar logic can be found in process 6.4.3.1(d) of the ASOS documentation))

        <u>b</u>   If the AWPAG temperature is set to "missing", set the AWPAG temperature to the latest ambient temperature reported by the AWPAG (bytes 16-20 of PD response). If the latest ambient temperature from the AWPAG is set to "missing" (999.9), set the AWPAG temperature to "missing".

        <u>c</u>   If the AWPAG temperature is greater than or equal to 35 degrees Fahrenheit, reset the current sensor status to "P" and proceed to step (c)(1) to process the sensor output as valid data.

    III. If the current response to the PD command indicates any diagnostic error other than a heater controller error (byte 8) or ring heater error (byte 9), or if the AWPAG temperature is less than 35 degrees Fahrenheit or is "missing":

      <u>a</u>   Set the one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

b   If the sensor condition is "operational", set the sensor condition to "inoperative". Write a message to the SYSLOG to indicate the change in sensor condition.

c   Set the previous sensor status = current sensor status.

d   Proceed to step (f).

(c) If the current sensor status in P1 response is "P":

(1) If the current accumulated precipitation reading is "99.99" or the current total precipitation reading is "99.99":

a   Set the current one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

b   Set the outage flag to "true". This indicates a pending recovery from a power outage at the sensor.

c   Set the previous sensor status = current sensor status.

d   Proceed to step (f).

(2) If the previous sensor status was "P" or "R":

a   Calculate the current one-minute precipitation amount by subtracting the previous accumulated precipitation reading from the current accumulated precipitation reading.

b   Set the previous accumulated precipitation reading to the current accumulated precipitation reading.

c   If the sensor condition is "inoperative", set the sensor condition to "operational". If sensor Data Quality status is set to "fail", reset Data Quality to "pass". Write a message to the SYSLOG to indicate the change in sensor condition.

d   Store the current date, time, and previous accumulated precipitation reading in non-volatile memory to indicate the latest receipt of valid data.

e   If the current total precipitation reading is greater than 42 inches (80% of the capacity of the gauge), display the total precipitation reading

using yellow characters on the maintenance page and send a message to the SYSLOG. Send additional message(s) to the SYSLOG only if the total precipitation reading decreases to less than 70% of the capacity of the gauge and then exceeds 80% again.

f   If the current accumulated precipitation reading is greater than 60.00 inches, poll the sensor with a "PRACC" command to reset the accumulated precipitation reading to zero. The "PRACC" command must be sent to the sensor well in advance of the next "P1" command in order to allow the sensor to reset the accumulated precipitation reading to zero. When a response to the "PRACC" command is received from the sensor, write a message to the SYSLOG indicating the reset of the accumulated precipitation parameter.

g   Proceed to step (f).

(3) If the previous sensor status was "F":

a   Set the current one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

b   Set the previous accumulated precipitation reading to the current accumulated precipitation reading.

c   Store the current date, time, and previous accumulated precipitation reading in non-volatile memory to indicate the latest receipt of valid data.

d   Set the previous sensor status = current sensor status.

e   Proceed to step (f).

(4) If the previous sensor status was "Missing":

a   Set the current one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

b   Set the previous accumulated precipitation reading to the current accumulated precipitation reading.

c   Calculate the recovered precipitation amount by subtracting the latest valid accumulated precipitation reading stored in non-volatile memory from the current accumulated precipitation reading. Write the recovered precipitation amount (including amounts equal to zero) in

the SYSLOG in the format "<last valid date/time> to <current date/time> recovered <recovered precipitation amount> inches".

    <u>d</u>   Store the current date, time, and previous accumulated precipitation reading in non-volatile memory to indicate the latest receipt of valid data.

    <u>e</u>   Proceed to step (f).

(a) If the current sensor status in the P1 response is "R":

    (1)   Set the outage flag to "false".

    (2)   Set the current one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

    (3)   Calculate the recovered precipitation amount by subtracting the latest valid accumulated precipitation reading stored in non-volatile memory from the current accumulated precipitation reading. Write the recovered precipitation amount (including amounts equal to zero) in the SYSLOG in the format "<last valid date/time> to <current date/time> recovered <recovered precipitation amount> inches".

    (4)   Set the previous accumulated precipitation reading to the current accumulated precipitation reading.

    (5)   Store the current date, time, and previous accumulated precipitation reading in non-volatile memory to indicate the latest receipt of valid data.

    (6)   Proceed to step (f).

(a) If the current sensor response from the P1 command is "?" or is not available:

    (1)   Set the one-minute precipitation amount to "missing". Write the one-minute precipitation amount to the 12-hour archive.

    (2)   If the sensor condition is "operational", set the sensor condition to "inoperative". Write a message to the SYSLOG to indicate the change in sensor condition.

    (3)   Set the previous sensor status = "Missing".

(b) Output

(1)   One-Minute Precipitation Amount

(2)   Previous Sensor Status

(3)   Sensor Condition to Maintenance Log (If Needed)

(4)   Outage Flag

(5)   Recovered Precipitation Amount to Maintenance Log (If Needed)