AUSTRALIA TELESCOPE

CSIRO DIVISION OF RADIOPHYSICS

CNR VIMIERA & PEMBROKE RDS, EPPING NSW
Table of Contents

1 Introduction 3

2 Operation of the Station 4
   2.1 Startup 4
   2.2 Restart 5
   2.3 Backups 5
   2.4 Data Archiving 6
   2.5 Examining the Archived Data 6

3 Hardware Overview 7

4 The Sensors 7
   4.1 Anemometer 7
   4.2 Wind Direction monitor 7
   4.3 Temperature Probes 8
   4.4 Solar Radiation (solarimeter) 8
   4.5 Barometer 8
   4.6 Rain Gauge 8
   4.7 Hygrometer 8
   4.8 Connecting the Sensors to the Logger 9

5 Programming the Logger 10
   5.1 Definition of the scanning task 10
   5.2 Definition of the channels to be interrogated 10
5.3 Definition of the calibration algorithms and factors to be applied 10

5.4 Conversing with the Orion 11

6 The PC programs 12

7 History and Acknowledgements 12

8 Appendices

A : The Data Logging program A1

B : The Data Examination program B1
Culgoora Weather Station

M. Kesteven

1 INTRODUCTION

An automated weather station has now been installed at Culgoora. A set of eleven weather statistics are recorded every hour:

a). wind speed - the mean, maximum, minimum and variance from the previous hour;

b). wind direction - hourly mean;

c). temperatures at ground level and at 10m level - five minute mean;

d). solar radiation - hourly mean;

e). barometric pressure - hourly mean;

f). rainfall - total accumulated during the previous hour;

g). humidity - hourly mean.

Additional software is provided to allow the archived data to be examined and listed.

This manual describes the operation of the unit, the hardware involved and the maintenance.
2 \textbf{OPERATION OF THE STATION}

The station is automatic - operator intervention is required only to start (or restart) the program, and to supervise the data archiving once a month. The data is written to a 5" floppy diskette every hour (on the hour). Although the diskette's capacity is adequate for several months operation, it would be wise to replace the diskette every month. The PC display maintains a tally of the amount of data stored on the diskette.

2.1 \textbf{Startup}

a). \textbf{The sensors}

The solar radiation monitor requires 240 v. There is a switch in the junction box at the base of the weather station tower; power to the tower derives from a switch board in the control building.

Two other sensors require power: the anemometer and the barometer. In both cases 24 v DC is needed, derived from the logger rack.

The remaining sensors are passive, and need no action to start operation.

b). \textbf{The logger}

The logger executes a scanning program: every 15 seconds it reads the sensors, scales the data to useful units and then sends the results to the PC. Switching on the logger will cause the program to be transferred from a cartridge tape; the program will then be started automatically. Recovery from a drastic power failure is equally automatic.

The logger has a key switch on the front panel. This needs to be set to the ON position. Two LEDs adjacent to the switch should be lit: one to indicate that the 24 v battery supply is on; the second LED indicates the operational state of the logger (ON or OFF).

Thus the operator's function on start-up is simple: ensure that the tape is in the reader, then switch the unit to ON.
c). The PC

The PC executes a simple task to accept the data from the logger, compile the statistics, and every hour, on the hour, archive the data.

The startup sequence:

1. Place the system in the upper drive, and the data disk in the lower drive.

2. Switch on the machine; after some diagnostics the computer will display its estimate of time and date. The operator should check that these are correct, and enter either a confirming RETURN or else the correct time/date. **NOTE:** the computer runs on AEST, and not Summer time.

3. Type:

   GWBASIC
   LOAD "ORION.BAS"
   RUN

4. The screen should then be cleared, and the current weather values displayed, accumulating over a period of time.

2.2 Restart

It is possible that a failure may occur after extended power failures, or after violent storms. In this case the logger and/or the PC may need restarting.

a). **Logger** : switch off, then ON.

b). **PC** : type RUN

This may produce the error message : "Communications buffer overflow". The response to this is to hit a number of RETURNS, then type: RUN

If all this fails, then switch off the computer and start again.

2.3 Backups

A backup logger program tape and a backup system disk for the PC are kept beside the units. Both are labelled as "Backup".
2.4 Data Archiving

The data is written to disk automatically, and needs no intervention. The PC display shows the time and date of the last record written; this should be checked periodically as a guide to the health of the PC operations.

Once a month the disk should be replaced with a fresh disk. Remove the disk from the lower drive and insert a fresh one (pre-initialised). This can be done at any time provided that the PC is not attempting to write to the disk - ie, check the time.

Spare (pre-initialised) disks are kept beside the machine.

Initialising the disks: use DISKCOPY on any other PC, with a pre-initialised disk as model.

The Archive disks should be sent to M. Kesteven.

2.5 Examining Archived Data

a). Find a spare PC.

b). Place the WEATHER system disk in the upper drive, and the archive data disk in the lower.

c). Type WEATHER to start the task.

d). Data filename: the standard filename is

   B:WEATHER.DAT

   e). Data can be listed and/or printed.

This task can be run on the current data disk: this can be removed from the logging PC provided that no data is to be written to the disk - ie, at times other than on the hour. Check the PC display.
3 HARDWARE OVERVIEW

The station consists of:

a). The sensors.

b). An "ORION" data logger which interrogates the sensors.

c). A P.C. computer which records the data and compiles some statistics.

The logger and the computer are battery powered so the weather station will continue to operate during power failures; however, the solar radiation monitor requires 240 volts power, so the solar radiation data may not be continuous.

4 THE SENSORS

4.1 The Anemometer

This is a WEATHERTRONICS device, model # 2030

It has three cups, 5 cm in diameter, on 8 cm arms. The rotating shaft carries a 30 slot optical chopper. An OPRON optoelectronic chopper (model OPB 804) detects the rotation of the shaft.

The scaling adopted: \[ V \text{ (km/hr)} = F \text{ (hz)} \times 0.158 + 0.837 \]

is derived from the WEATHERTRONICS manual.

The wiring diagram for the unit is shown in fig. 1

24 v DC is required; this is derived from the logger rack power supply.

4.2 The Wind Direction Monitor

This is a WEATHERTRONICS device, model #2020

The weather vane drives a 5kΩ variable resistor.
4.3 The Temperature Probes

These are all four-wire platinum resistor thermometers. Although NML calibration curves are available for all units, we have chosen to use the calibration factors built into the logger.

4.4 Solar Radiation (solarimeter)

This is a CASELLA device, model #W6500

The unit requires +10v and -8v power, derived from a 240v unit. It returns a DC analogue voltage, 1 mV/(W/m²).

4.5 The Barometer

This is a WEATHERTRONICS device, model #7100

It requires 24v DC supply, provided directly from the logger rack. The unit is mounted on the logger rack, with a hose connected to the outside to provide the ambient pressure. It returns a DC analogue voltage proportional to the pressure.

The scaling: \( P \ (\text{mb}) = V \times 100 \times 600 \). This comes from the manual.

4.6 The Rainfall Gauge

This is a WEATHERTRONICS device, model #P501 - I/PN 648001

The unit contains a small tipping bucket, each tip corresponding to 0.25 mm of rain. Each "tip" produces a pulse which is counted by the logger.

4.7 The Hygrometer

Not yet installed.
4.8 CONNECTING THE SENSORS TO THE LOGGER

All the sensors except for the barometer are located on the weather tower to the E of the control building. Four sensors are mounted at the tower top: the anemometer and wind direction; a temperature probe and the hygrometer. A second temperature probe and the solar radiation monitor are at ground level. The rain gauge is some 10m to the south of the tower.

The wiring diagram for the junction box at the tower top is shown in fig. 2; the wiring diagram for the ground level junction box is in fig. 3, and the connections at the logger rack are shown in fig. 4.

The anemometer is connected to channel 5 in the Counter/Timer module of the logger, as shown in figs 5 and 6.

The rain gauge is connected to channel 21 in the Event/Status module, as shown in fig. 7.

All the other sensors are connected to the Reed relay unit, as shown in figs 8, 9, 10, 11 and 12.
The scanning task in the logger is called "weather", and occupies slot #1 on the tape. The program contains:

5.1 Definition of the scanning task

In ORION terms:

<table>
<thead>
<tr>
<th>TA1 OP ME</th>
<th>This is a measurement task</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA1 TR TI DE 5.0</td>
<td>Start after a 5 second delay</td>
</tr>
<tr>
<td>TA1 CO * RE IN IN 0:0:15.</td>
<td>Continuous scanning, looping every 15 s</td>
</tr>
<tr>
<td>TA1 CH1-5,21,61-65,67,68-70</td>
<td>These are the channels to scan</td>
</tr>
<tr>
<td>TA1 AT F</td>
<td>Take 10 readings per sensor</td>
</tr>
<tr>
<td>TA1 LO EV</td>
<td>Log every channel sampled</td>
</tr>
<tr>
<td>TA1 MA EV</td>
<td>And send a time stamp</td>
</tr>
<tr>
<td>TA1 FO CO</td>
<td>Using a compact format</td>
</tr>
<tr>
<td>TA1 TO S0</td>
<td>Send the data to the RS232 port S0</td>
</tr>
</tbody>
</table>

5.2 Definition of the channels to be interrogated

In ORION terms:

<table>
<thead>
<tr>
<th>CH1-5 SE 902 CO1</th>
<th>Wind speed; frequency measurement, 1.0 sec gate; Conversion routine #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH21 SE 741 CO2</td>
<td>Rain gauge; count events</td>
</tr>
<tr>
<td>CH61 SE 410</td>
<td>Ground level T; 4-wire platinum resistor</td>
</tr>
<tr>
<td>CH63 SE 410</td>
<td>10m level T</td>
</tr>
<tr>
<td>CH65 SE 410</td>
<td>Room T</td>
</tr>
<tr>
<td>CH67 SE 254 CO3</td>
<td>Wind direction; resistance measurement</td>
</tr>
<tr>
<td>CH68 SE 114 CO4</td>
<td>Solar radiation; voltage measurement</td>
</tr>
<tr>
<td>CH69 SE 114 CO5</td>
<td>Barometric pressure</td>
</tr>
<tr>
<td>CH70 SE 114 CO6</td>
<td>Relative Humidity</td>
</tr>
</tbody>
</table>

5.3 Definition of the calibration algorithms and factors to be applied

In ORION terms:

<table>
<thead>
<tr>
<th>CO1 MO SC MC 0.158, 0.837 UN KMH</th>
<th>Conversion routine #1, linear scaling (0.158*x + 0.837), units</th>
</tr>
</thead>
<tbody>
<tr>
<td>km/h</td>
<td></td>
</tr>
</tbody>
</table>
CO2 MO SC MC 0.25, 0. UN MM
CO3 MO SC MC 0.072, 0. UN DEG
CO4 MO SC MC 1000,.0. UN WM2
CO5 MO SC MC 100., 600. UN MB
CO6 MO SC MC 1., 0. UN %

5.4 CONVERSING WITH THE ORION

The ORION's RS232 output is currently set to: 300 baud, 7 bits, EVEN parity, 1 stop bit.

A terminal should be connected (in place of the PC).

Communication with the ORION is a bit complicated because of the need to distinguish the two competing output channels which share the same RS232 output port: the microprocessor port and the data port. A simple protocol allows the user to switch from one to the other:

! to gain attention of the ORION's microprocessor
# to release the ORION, and open the data path.

The procedure to modify a program, for example would be:

! This should return C:
HALT To stop any current task C:
TA1 OP ME ... etc

# If data is to flow to S0.

Note: all communication to the ORION must be in upper case.

Further details on the commands available are described in the ORION manual.
6  THE PC PROGRAMS

"ORION", the PC logging task is listed in appendix A. The task runs under GWBASIC. (An as yet unresolved problem prevents a compiled version running)

"WEATHER", the task to examine the archival data is listed in appendix B. This task is compilable.

7  HISTORY AND ACKNOWLEDGEMENTS

The weather tower was designed by C.J. van der Meulen. The sensors were installed by E.Broderick, with W.Payten supervising. A.Spencer designed and built the pulse shaper/driver for the anemometer. B.Whitelaw drew the diagrams.
Appendix A

The Data Logging Program

10 '  ORION weather station logging task
30 ' 40 ' mjk 11 - NOV - 87
50 ' 60 ' ........................................
70 ' 80 DIM POINTS(8), V.DATA(8)
90 DIM A.NDX(100), B.NDX(100)
95 DIM ARR.DAT(6,10), INDX(100)
100 ' 110 FALSE = 0: TRUE = NOT FALSE
115 PI = 3.1415926#
117 TM.LOG$ = " (none yet) "
118 KEY OFF
119 T.FACT = .9
120 BLANK$ = STRING$(8,32)
125 ' 130 OPEN "COM1:" AS #1
140 ' 150 SKIP = 5
160 ' 165 GOSUB 2000 : ' task initialiser
170 GOSUB 1250 : ' screen initialiser
180 ' 190 ' 200 FIRST.REC = TRUE
210 ' simple minded loop
220 ' 230 MSG$ = " "
240 ' 250 WHILE LOC(1)<>0
260 A$ = INPUT$(1, #1)
270 IF (A$ = CHR$(13)) GOTO 370
280 IF (A$ = CHR$(10)) GOTO 370
290 MSG$ = MSG$ + A$
300 ' 310 GOSUB 560
320 GOTO 500
330 ' 340 ' 350 '

ORION.BAS  A1  6/29/88 15:46
360 ' decide if there is anything worth printing
370 ' 380 IF (NOT FIRST.REC) GOTO 460
390 MSG$ = " "
400 FIRST.REC = FALSE
410 GOTO 510
420 ' 430 GOSUB 660
440 GOSUB 1100
450 ' 460 MSG$ = " "
470 ' 480 WEND
490 ' 500 THIS.HR = VAL(MID$(TIME$,1,2))
510 IF (THIS.HR <> LAST.HR) THEN GOSUB 4000
520 ' 530 A$ = INKEY$
540 IF ((A$="Q") OR (A$="q")) THEN GOTO 545
550 ' 560 GOTO 210
570 ' 580 GOSUB 4000 : write a last record
590 ' 600 CLS
610 PRINT: PRINT " Weather logger stopped"
620 PRINT:
630 PRINT "data file now has "; N.RECORDS; " records"
640 ' 650 END
660 ' 670 SUBROUTINE TO WASTE TIME
680 ' 690 J = 0
700 FOR I = 1 TO SKIP
710 J = J + 1
720 NEXT I
730 ' 740 RETURN
750 ' subroutine to parse an input line
760 ' 770 PNT = LEN(MSG$)
780 ' 790 N1 = 1
800 NTERMS = 0
810 '
FOR I = N1 TO PNT
IF (ASC(MID$(MSG$,I,1)) > 32) GOTO 770
NEXT I
GOTO 1080

N1 = I
is this time?

IF (MID$(MSG$,N1,1) <> "S") GOTO 880

NTERMS = 1
POINTS(1) = -1
TM.STR$ = MID$(MSG$,N1+6,10)
TIME$ = TM.STR$
TM.STR$ = TIME$
GOTO 1080

"." ?

IF (MID$(MSG$,N1,1) <> ":") GOTO 940
N1 = N1 + 19
IF (N1 < PNT) GOTO 940
GOTO 1080

IF (MID$(MSG$,N1,1) <> "C") GOTO 1030:
NTERMS = NTERMS + 1
PT = VAL(MID$(MSG$,N1+2,3))
POINTS(NTERMS) = PT
IF ((PT>0) AND (PT<6)) THEN POINTS(NTERMS) = 1
V.DATA(NTERMS) = VAL(MID$(MSG$,N1+6,7))
N1 = N1 + 20
IF (N1 < PNT) GOTO 720
GOTO 1080

GOTO 1080

IF (MID$(MSG$,N1,1) = "D") GOTO 1080
PRINT ":possible trouble : "
PRINT MSG$
RETURN

Subroutine to describe the values found

IF (NTERMS = 0) GOTO 1220
FOR I = 1 TO NTERMS
IF (POINTS(I) = -1) GOTO 1200
A1 = A.NDX(POINTS(I)) : B1 = B.NDX(POINTS(I))
LOCATE A1,B1 : PRINT BLANK$
LOCATE A1, B1: PRINT USING "#####.##": V.DATA(I)
J = INDX(POINTS(I))
GOSUB 7000 : ' update the data
GOTO 1210
LOCATE 6, 33: PRINT TM.STR$
NEXT I
RETURN
.......................
' subroutine to initialise the screen
CLS
LOCATE 2, 10
PRINT "Culgoora weather station and logger - jan6/88 version"
LOCATE 3, 60
PRINT DATE$
LOCATE 6, 5
PRINT "time of last data sample : ":
LOCATE 8, 1 : PRINT "wind speed : ":
LOCATE 8, 25: PRINT "k/hr"
A.NDX(1) = 8: B.NDX(1) = 15
A.NDX(2) = 8: B.NDX(2) = 15
LOCATE 8, 40: PRINT "wind direction : ":
LOCATE 8, 70: PRINT "degs"
A.NDX(67) = 8: B.NDX(67) = 60
LOCATE 11, 1
PRINT "ground temp : ":
LOCATE 11, 25: PRINT "C"
A.NDX(61) = 11: B.NDX(61) = 15
LOCATE 11, 40
PRINT "10m temp : ":
LOCATE 11, 70: PRINT "C"
A.NDX(63) = 11: B.NDX(63) = 60
LOCATE 14, 1
PRINT "precipitation : ":
LOCATE 14, 25: PRINT "mm"
A.NDX(21) = 14: B.NDX(21) = 15
LOCATE 14, 40
PRINT "humidity : ":
LOCATE 14, 70: PRINT "%"
A.NDX(70) = 14: B.NDX(70) = 60
LOCATE 17,1
PRINT "pressure : "
LOCATE 17,25 : PRINT "mb"
A.NDX(69) = 17 : B.NDX(69) = 15
LOCATE 17,40
PRINT "sol. rad : "
LOCATE 17,70 : PRINT "W/sqm"
A.NDX(68) = 17 : B.NDX(68) = 60

LOCATE 20,1 : PRINT "room temp : "
LOCATE 20, 25: PRINT 'C'
A.NDX(65) = 20: B.NDX(65) = 15
LOCATE 22,1
PRINT "Last record at "; TM.LOG$;
PRINT " there are now "; N.RECORDS; " records on disk"
PRINT " This task started on "; STRT.DATE$;
PRINT " at "; STRT.TIMES$

LOCATE 25,1
PRINT "Type Q to halt task";
RETURN

' Subroutine to initialise the various arrays

STRT.DATE$ = DATE$
STRT.TIMES$ = TIMES$
GOSUB 3000 : ' zeroes the data array

INDX(1) = 1 : ' wind speed
INDX(2) = 1 : ' wind speed
INDX(21) = 6 : ' precipitation
INDX(61) = 3 : ' ground level temperature
INDX(63) = 4 : ' 10 m temp
INDX(65) = 5 : ' room temperature
INDX(67) = 2 : ' wind direction
INDX(68) = 9 : ' solar radiation
INDX(69) = 7 : ' pressure
INDX(70) = 8 : ' humidity

LAST.HR = VAL(MID$(TIMES$,1,2))
OPEN "b:records.dat" FOR INPUT AS #3
INPUT #3, N.RECORDS
CLOSE #3

RETURN
Subroutine
 zeroes the data array
 FOR I = 1 TO 2
 FOR J = 1 TO 6
   ARR.DAT(J,I) = 0!
 IF (J=3) THEN ARR.DAT(J,I) = 1000000!
 NEXT J
 NEXT I
 FOR I = 1 TO 9
 FOR J = 4 TO 6
   ARR.DAT(J,I) = 0!
 NEXT J
 NEXT I
 ARR.DAT(5,3) = 1!
 ARR.DAT(5,4) = 1!
 RETURN

Subroutine to log data to disk
 OPEN "b:weather.dat" FOR APPEND AS #2
 TM.LOG$ = TIMES$
 PRINT #2, TM.LOG$, DATES$
 gather the statistics
 wind
 J = 1
 GOSUB 5000
 wind direction
 J = 2
 GOSUB 6000
 ground temp
 J = 3
 GOSUB 5000
 10 m temp
 J = 4
 GOSUB 5000
 pressure
 J = 7
 GOSUB 5000
J = 8 : ' humidity
GOSUB 5000

J = 9 : ' INSOLATION
GOSUB 5000

PRINT #2, ARR.DAT(4,1), ARR.DAT(5,1), ARR.DAT(2,1),
     ARR.DAT(3,1)
PRINT #2, ARR.DAT(2,2), ARR.DAT(4,3), ARR.DAT(4,4),
     ARR.DAT(4,7)
PRINT #2, ARR.DAT(1,6), ARR.DAT(4,8), ARR.DAT(4,9)

CLOSE (2)

GOSUB 9000 : ' update record number counter
GOSUB 3000 : ' zero the data arrays
GOSUB 1250 : ' refresh the screen

LAST.HR = THIS.HR

RETURN

subroutine

generate the statistics

WEIGHT = ARR.DAT(6,J)

IF (WEIGHT = 0) GOTO 5150

MEAN = ARR.DAT(4,J) / WEIGHT

RMS = ARR.DAT(5,J) / WEIGHT - MEAN*MEAN

IF (RMS < 0) GOTO 5160

RMS = SQR (RMS)

GOTO 5200

problems

RMS = 0!

ARR.DAT(4,J) = MEAN
ARR.DAT(5,J) = RMS

RETURN

subroutine to deal with the wind direction
6010 '  
6020 IF (ARR.DAT(1,J) = 0 ) GOTO 6500  
6030 '  
6040 CC = ARR.DAT(4,J)  
6050 SS = ARR.DAT(5,J)  
6060 '  
6070 GOSUB 8000 : ' get ATAN2D  
6160 '  
6170 ARR.DAT(2,J) = TT  
6180 '  
6500 RETURN  
6505 ' ..........................................................  
6999 '  
7000 ' Subroutine to update the data arrays  
7010 '  
7015 DATUM = V.DAT(A(I))  
7020 ARR.DAT(1,J) = DATUM  
7030 '  
7040 IF (J = 2) GOTO 7500 : ' wind direction  
7042 IF (J = 3) GOTO 7700 : ' temperature  
7044 IF (J = 4) GOTO 7700  
7050 '  
7060 TMP = ARR.DAT(1,J)  
7070 ARR.DAT(4,J) = ARR.DAT(4,J) + TMP  
7080 ARR.DAT(5,J) = ARR.DAT(5,J) + TMP*TMP  
7090 ARR.DAT(6,J) = ARR.DAT(6,J) + 1  
7100 '  
7110 IF (ARR.DAT(2,J) < TMP) THEN ARR.DAT(2,J) = TMP  
7120 IF (ARR.DAT(3,J) > TMP) THEN ARR.DAT(3,J) = TMP  
7130 '  
7140 ' check daily wind max/min  
7150 '  
7160 IF (J <> 1) GOTO 7800  
7170 '  
7180 IF (ARR.DAT(2,10) < TMP) THEN ARR.DAT(2,10) = TMP  
7190 IF (ARR.DAT(3,10) > TMP) THEN ARR.DAT(3,10) = TMP  
7200 GOTO 7800  
7210 '  
7500 T = ARR.DAT(1,2)  
7510 T = T * PI / 180!  
7520 SPEED = ARR.DAT(1,1)  
7530 '  
7540 C = COS(T) * SPEED  
7550 S = SIN(T) * SPEED  
7560 '  
7570 ARR.DAT(4,2) = ARR.DAT(4,2) + C  
7580 ARR.DAT(5,2) = ARR.DAT(5,2) + S  
7590 ARR.DAT(6,2) = ARR.DAT(6,2) + 1  
7600 '
7610  CC = ARR.DAT(4,2)
7620  SS = ARR.DAT(5,2)
7630  GOSUB 8000  : 'get atan2D
7640  
7650  ARR.DAT(2,2) = TT
7660  
7665  GOTO 7800
7667  
7700  ' temperature: want 5 min. averaging
7705  
7710  ARR.DAT(4,J) = ARR.DAT(4,J)*FACT + DATUM
7715  ARR.DAT(6,J) = ARR.DAT(6,J) + ARR.DAT(5,J)
7720  ARR.DAT(5,J) = ARR.DAT(5,J)*FACT
7725  
7800  RETURN
7805  '..............................................................
7999  '  subroutine to evaluate ATAN2D
8000  
8010  
8060  IF (CC <> 0) GOTO 8110
8070  TT = PI / 2!
8080  IF (SS < 0) THEN TT = -PI/2!
8090  GOTO 8500
8100  
8110  TT = SS / CC
8120  TT = ATN(TT)
8130  IF (CC < 0) THEN TT = TT + PI
8140  
8150  TT = TT * 180! / PI
8160  
8500  RETURN
8505  '..............................................................
8999  '
9000  ' subroutine
9010  ' updates the record counter file
9020  
9030  OPEN "b:records.dat" FOR INPUT AS #3
9040  INPUT #3, N.RECORDS
9050  CLOSE #3
9060  
9070  N.RECORDS = N.RECORDS + 1
9080  
9090  OPEN "b:records.dat" FOR OUTPUT AS #3
9100  PRINT #3, N.RECORDS
9110  CLOSE #3
9120  
9130  RETURN
Appendix B

The Data Examination Program

20 ' Weather data analysis
30 ' mjk, 7/jan/88
50 ' ..............................
80 ' DIM ARR.DAT(11), WANT(11), L.TITLE$(11), L.UNIT$(11)
100 ' FALSE = 0: TRUE = NOT FALSE
120 ' KEY OFF
140 ' GOSUB 2290 : initialise titles
160 ' CLS: LOCATE 5,5
180 INPUT " Enter data filename : ", IN.FIL$
190 ' OPEN IN.FIL$ FOR INPUT AS #1
210 ' LOCATE 7,5: PRINT " Patience while we read the file ":
230 ' find the first record
250 ' N.LINE = 0
270 LINE INPUT #1, F.MSG$
290 N.LINE = N.LINE + 1
300 IF (N.LINE>10) GOTO 860 : probable error
310 IF (MID$(F.MSG$,3,1)<>"." ) GOTO 280
320 ' GOSUB 960 : read the 3 lines of the first record
340 ' N.REC = 1
350 WHILE (NOT EOF(1))
370 LINE INPUT #1, MSG$
380 IF (MID$(MSG$,3,1)<>"." ) GOTO 370 : resynch if necessary
390 GOSUB 960 : read 3 lines of data
400 N.REC = N.REC + 1
410 WEND
420 ' CLOSE #1
440 '  
450 '  
460 P.DATES$ = "01-01-1900"
470 OPEN IN.FIL$ FOR INPUT AS #1
480 '  
485 SKIP = FALSE
490 MORE = TRUE
500 WHILE (MORE)
510 '  
520 GOSUB 1360 : ' options setup
530 '  
540 IF (NOT MORE) GOTO 800
550 '  
560 FOUND = FALSE
570 '  
580 WHILE (NOT EOF(1))
590 '  
600 IF (NOT SKIP) THEN LINE INPUT #1, T.MSG$
605 SKIP = FALSE
610 IF (MID$(T.MSG$,3,1) <> ":") GOTO 600
620 IF (MID$(T.MSG$,15,10)<=L.DATES$) GOTO 680
630 '  
640 GOSUB 1050 : ' read and print the data
650 FOUND = TRUE
660 GOTO 710
670 '  
680 IF (FOUND) GOTO 730 : ' can quit
690 '  
700 GOSUB 960 : ' skip 3 lines
710 WEND
720 '  
730 '  
740 PRINT
750 '  
760 IN.MSG$ = "Continue"
770 GOSUB 2160 : ' asks for yes/no to continue
780 MORE = ANS
790 '  
800 WEND
810 '  
820 CLOSE #1
830 '  
840 END
850 ' ..............................................................
860 ' error exit
870 '  
880 CLOSE #1
890 CLS
900 PRINT
PRINT "No time stamp found"
PRINT "Is "; IN.FIL$; " the correct filename?"
PRINT
STOP

 subroutine
 reads 3 lines, no data resulting
 LINE INPUT #1, C1$
 LINE INPUT #1, C2$
 LINE INPUT #1, C3$
 RETURN

 subroutine
 reads 3 lines; extracts 10 items
 FOR I = 1 TO 11
 IF ((I=11) AND (L.DATE$<"01-08-1988")) GOTO 1120
 INPUT #1, ARR.DAT(I)
 NEXT I
 GOSUB 1180 : ' print
 RETURN

 subroutine
 prints the required data
 PRINT MID$(T.MSG$,1,8);
 IF (L.PRINT) THEN LPRINT MID$(T.MSG$,1,8);
 FOR I = 1 TO 11
 IF (NOT WANT(I)) GOTO 1300
 PRINT USING "#####."; ARR.DAT(I);
 IF (L.PRINT) THEN LPRINT USING "#####."; ARR.DAT(I);
 NEXT I
 PRINT ":
 IF (L.PRINT) THEN LPRINT " ":
 RETURN
 subroutine
 options setup
 CLS
PRINT " There are "; N.REC; " records
PRINT " from "; F.MSG$
PRINT " to "; MSG$
F.DATE$ = MID$(F.MSG$,15,10)
E.DATE$ = MID$(MSG$,15,10)
IF (NOT FOUND) THEN P.DATE$ = "01-01-1900"
LOCATE 6,2
INPUT "Enter date to list (mm-dd-yyyy) ":", L.DATE$
IF ((L.DATE$>=F.DATE$)AND(L.DATE$<=E.DATE$)) GOTO 1560
ERR.MSG$ = "Date not on file"
GOSUB 2680
GOTO 1490
LOCATE 8,2
IN.MSG$ = "Do you want to change the options? 
GOSUB 2160
IF (NOT ANS) GOTO 1830
IN.MSG$ = "Do you want to list on the printer? 
GOSUB 2160
L.PRINT = ANS
PRINT "Options: Wind speed,rms,max,min"
PRINT " wind dir, temps (ground level and 10m)"
PRINT " pressure, precipitation, humidity"
PRINT " numbered 1 to 11"
INPUT "Enter number of items to list (<9) ":", L.NUM
IF (L.NUM>9) THEN L.NUM = 8
FOR I = 1 TO 11
WANT(I) = FALSE
NEXT I
FOR I = 1 TO L.NUM
PRINT "Enter "; I; "th. item number ";
INPUT ";", J
WANT(J) = TRUE
NEXT I
SKIP = TRUE
IF (L.DATE$>P.DATE$) GOTO 1870
CLOSE #1
OPEN IN.FILE$ FOR INPUT AS #1
SKIP = FALSE
1870 P.DATES$ = L.DATES$
1880 '  
1890 PRINT
1900 PRINT L.DATES$ : PRINT
1910 IF (NOT L.PRINT) GOTO 1940
1920 LPRINT: LPRINT L.DATES$: LPRINT
1930 '  
1940 PRINT " time ": IF (L.PRINT) THEN LPRINT " time ";
1950 FOR I = 1 TO 11
1960 IF (NOT WANT(I)) GOTO 1990
1970 PRINT L.TITLE$(I);
1980 IF (L.PRINT) THEN LPRINT L.TITLE$(I);
1990 NEXT I
2000 PRINT " 
2010 IF (NOT L.PRINT) GOTO 2030
2020 LPRINT " 
2030 '  
2040 PRINT " ": IF (L.PRINT) THEN LPRINT " ";
2050 FOR I = 1 TO 11
2060 IF (NOT WANT(I)) GOTO 2090
2070 PRINT L.UNITS$(I);
2080 IF (L.PRINT) THEN LPRINT L.UNITS$(I);
2090 NEXT I
2100 PRINT " ": PRINT
2110 IF (NOT L.PRINT) GOTO 2130
2120 LPRINT " ": LPRINT " 
2130 '  
2140 RETURN
2150 ' ..............................................
2160 ' subroutine
2170 ' asks for a yes/no response
2180 ' returns ans (logical)
2190 '  
2200 OUT.MSG$ = IN.MSG$ + " [y/n] "
2210 PRINT OUT.MSG$;
2220 INPUT ": ", CH$
2230 '  
2240 ANS = TRUE
2250 IF ((CH$="n") OR (CH$="N")) THEN ANS = FALSE
2260 '  
2270 RETURN
2280 ' ..............................................
2290 ' subroutine
2300 ' initialise the titles and options
2310 '  
2320 L.TITLE$(1) = " speed"
2330 L.TITLE$(2) = " rms ">
2340 L.TITLE$(3) = " max ">
2350 L.TITLE$(4) = " min ">

WEATHER.BAS  B5  6/29/88 1532
2360   L.TITLE$(5) = "dirtn"
2370   L.TITLE$(6) = " T(gr)"
2380   L.TITLE$(7) = " T(10)"
2390   L.TITLE$(8) = " Press"
2400   L.TITLE$(9) = " Rain "
2410   L.TITLE$(10) = " Humid"
2420   L.TITLE$(11) = " Sun "
2430   
2440   L.UNITS$(1) = " km/hr"
2450   L.UNITS$(2) = " km/hr"
2460   L.UNITS$(3) = " km/hr"
2470   L.UNITS$(4) = " km/hr"
2480   L.UNITS$(5) = " degs "
2490   L.UNITS$(6) = " C "
2500   L.UNITS$(7) = " C "
2510   L.UNITS$(8) = " mbars"
2520   L.UNITS$(9) = " mm "
2530   L.UNITS$(10) = " % "
2540   L.UNITS$(11) = " w/sqm"
2550   
2560   L.PRINT = FALSE
2570   FOR I = 1 TO 11
2580      WANT(I) = FALSE
2590   NEXT I
2600   
2610   WANT(1) = TRUE
2620   WANT(3) = TRUE
2630   WANT(4) = TRUE
2640   WANT(6) = TRUE
2650   
2660   RETURN
2670   
2680   subroutine
2690   error report
2700   
2710   LOCATE 25,1
2720   PRINT ERR.MGS$ 
2730   
2740   BEEP: BEEP
2750   
2760   RETURN
2770   
2780   subroutine
2790   extract N.VAL items from the string C.STR$
2800   
2810   L = LEN(C.STR$)
2820   
2830   FI = 0
2840   FOR I = 1 TO N.VAL

WEATHER.BAS
2850   F1 = F1 + 1
2860   IF (F1>L) GOTO 2990
2870   IF (MID$(C.STR$,F1,1) = " ") GOTO 2850
2880   
2890   F2 = F1
2900   F2 = F2 + 1
2910   IF (F2>L) GOTO 2940
2920   IF (MID$(C.STR$,F2,1) <> " ") GOTO 2900
2930   
2940   
2950   F3 = F2 - F1
2960   TMP = VAL(MID$(C.STR$,F1,F3))
2970   GOTO 3010
2980   
2990   TMP = -1
3000   
3010   INDX = N.START + (I-1)
3020   ARR.DAT(INDX) = TMP
3030   
3040   NEXT I
3050   
3060   RETURN
CULGOORA WEATHER STATION

Note: a TTL probe shaper has been added to PR2 (anemometer)

Fig. 3

TO TOP JUNCTION BOX
(Posts 7 to 11 inclusive)

24 VOLT POWER CABLE
TO RADIO BUILDING

12 PAIR DATA CABLE
TO RADIO BUILDING
CULGOORA WEATHER STATION
CABLE TERMINATION LOGGER RACK

SPARE

SPARE TO BOT BOX

RAIN GAUGE

SOLARIMETER

BOT TEMP1

BOT TEMP2

SPARE TO TOP BOX

HUMIDITY

TOP TEMP1

TOP TEMP2

WIND SPEED

WIND DIRECT

COMMUNICATION CABLE SHIELD

Fig. 4
Fig. 7.3 *Location of switches S1-S5*

**PL1 Connections**

- 12V
- 0V
- +5V TTL
- Channel 1 Windspeed

**PL1 signals**

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1-</td>
</tr>
<tr>
<td>2</td>
<td>G1-</td>
</tr>
<tr>
<td>3</td>
<td>F2-</td>
</tr>
<tr>
<td>4</td>
<td>G2-</td>
</tr>
<tr>
<td>5</td>
<td>F3-</td>
</tr>
<tr>
<td>6</td>
<td>G3-</td>
</tr>
<tr>
<td>7</td>
<td>F4-</td>
</tr>
<tr>
<td>8</td>
<td>G4-</td>
</tr>
<tr>
<td>9</td>
<td>F5-</td>
</tr>
<tr>
<td>10</td>
<td>G5-</td>
</tr>
<tr>
<td>11</td>
<td>+19V</td>
</tr>
<tr>
<td>12</td>
<td>0V</td>
</tr>
<tr>
<td>13</td>
<td>0V19</td>
</tr>
<tr>
<td>14</td>
<td>F1+</td>
</tr>
<tr>
<td>15</td>
<td>G1+</td>
</tr>
<tr>
<td>16</td>
<td>F2+</td>
</tr>
<tr>
<td>17</td>
<td>G2+</td>
</tr>
<tr>
<td>18</td>
<td>F3+</td>
</tr>
<tr>
<td>19</td>
<td>G3+</td>
</tr>
<tr>
<td>20</td>
<td>F4+</td>
</tr>
<tr>
<td>21</td>
<td>G4+</td>
</tr>
<tr>
<td>22</td>
<td>F5+</td>
</tr>
<tr>
<td>23</td>
<td>G5+</td>
</tr>
<tr>
<td>24</td>
<td>-30V FOR TEST</td>
</tr>
<tr>
<td>25</td>
<td>+12V PURPOSES ONLY</td>
</tr>
</tbody>
</table>

**Fig. 5 PL1 Pin Numbering**

- COUNTER TIMER 35302C
- Customer's connector viewed from rear
- Customer's connector type: Cannon D29S
TTL INPUTS: Active Hi

*Input connections for a floating signal source*

Channel 1
Windspeed

5V ACTIVE —
0V

PART OF COUNTER/TIMER

PL1

+19V

PART OF SWITCH (S1–S5)
F or G HALF AS APPROPRIATE

EARTH RETURN (VIA EARTH PIN IN LOGGER MAINS PLUG)

F and G INPUT CIRCUITS ARE IDENTICAL

*S1 to S5 Settings (for floating or earthed signal source)*

**Required Switch Settings S1**

S1 to S5 RELATE TO CHANNELS 1 to 5 RESPECTIVELY

<table>
<thead>
<tr>
<th>Switch</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>closed</td>
</tr>
<tr>
<td>G</td>
<td>open</td>
</tr>
</tbody>
</table>

**Both F and G switches are shown set for TTL active hi input. F and G switches may be set independently for differential or TTL as required. (Differential settings are shown in Fig. 7.1)**

Fig. 6 TTL Inputs: Active Hi
Event/Status Module  Slot 5  35302A
Rain Gauge Connections

Event Recording

INPUT CONNECTOR ASSEMBLY
(COVER PLATE REMOVED)

H  Hi  Lo  see H & L TERMINALS below
+  5V floating supply

Rain Gauge Sw.

Switch Closure.
Gives Logic H to Logic L
Log event Hi → Lo

DIGITAL CHANNELS

<table>
<thead>
<tr>
<th>21</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>23</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25</th>
<th>26</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>27</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>29</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>31</th>
<th>32</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>33</th>
<th>34</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>35</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>37</th>
<th>38</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>39</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

**NUMBERING**
Numbering for channels 1-20 only is shown; subsequent sets of
20 channels are similarly numbered, i.e. 21-40, 41 to 60, and so on,
up to 181-200.
Channel numbering on any input connector is dependent on
which slot it occupies in the logger mainframe.

**H & L TERMINALS**
For each input channel circuit to conduct, the H terminal must
have a +ve potential with respect to the L terminal. When the
input circuit conducts the logger gives a measurement of Logic 0.
When the input circuit does not conduct the logger gives a
measurement of Logic 1.

Fig 7. Input connector: Channel Numbering and Pin Assignment.
Fig. 8 Channel Numbering and Assignment of Terminals on Input Connectors
2.5 4-TERMINAL RESISTANCE OR PRT MEASUREMENT

2.5.1 Theoretical Diagram

The energising current is generated and switched automatically, no additional linking or connections are required.

2.5.2 Practical Connection Diagram

Slot 7

Connection Diagram for PRTs

PRT 1. Tower top ch. 61
PRT 2. Tower bot ch. 63
PRT 3. Room Temp ch. 65

Fig. 9
2.4 2-TERMINAL RESISTANCE MEASUREMENT

2.4.1 Theoretical Diagram

2.4.2 Practical Connection Diagram

Wind Direction Connection

Resistance Measurement

N.B. Use Reed Relay Selector 35301A only. 2-terminal resistance measurement is suitable for applications where less accuracy is required (e.g. measuring 10k to 1% accuracy). For greater accuracy, use 4-terminal resistance measurement, see page 4.24.

Fig. 10
2.2 VOLTAGE MEASUREMENT

2.2.1 Theoretical Diagram

2.2.2 Practical Connection Diagram

Fig. 11
2.2 VOLTAGE MEASUREMENT

2.2.1 Theoretical Diagram

SP1 OR SP2
SPLIT PAD ON REED SELECTOR.
IF BRIDGED, COMMITS ALL
10 ASSOCIATED CHANNELS
TO SAME L-TO-G CONNECTION.
(SP1 - ODD CHANNELS
SP2 - EVEN CHANNELS)
SEE PAGE 4.21.

2.2.2 Practical Connection Diagram

Slot 7
Channel 69
Barometric Pressure

CONNECT G TO GUARD, SCREEN
OR SOURCE OF COMMON MODE POTENTIAL,
OR CONNECT G TO L, AT POINT OF MEASUREMENT
OR USING SPLIT PAD IN LOGGER.

Fig. 12
INTERRUPTER ASSEMBLIES

Non-contact switching is provided by OPTRON's optoelectronic interrupter assemblies which consist of a high efficiency gallium arsenide LED and silicon N-P-N phototransistor or photodarlington in a molded plastic housing. A gap in the optoelectronic characteristics (25°C)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ON-STATE COLLECTOR CURRENT</th>
<th>OFF-STATE COLLECTOR CURRENT</th>
<th>SATURATION VOLTAGE</th>
<th>LED FORWARD VOLTAGE</th>
<th>RESPONSE TIME</th>
<th>SLUG WIDTH</th>
<th>OUTPUT CONFIGURATION</th>
<th>CASE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST CONDITION</td>
<td>V_CES=10 V</td>
<td>V_CES=10 V</td>
<td>I_C and I_F</td>
<td>I_F</td>
<td>R_L=1MΩ 2S</td>
<td>V_CES=5 V</td>
<td>I_F=40 mA</td>
<td></td>
</tr>
<tr>
<td>SYMBOL</td>
<td>I_L</td>
<td>I_D</td>
<td>V_CE(SAT)</td>
<td>V_F</td>
<td>t_F</td>
<td>t_C</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>mA</td>
<td>mA</td>
<td>MAX</td>
<td>mA</td>
<td>mA</td>
<td>MAX</td>
<td>mA</td>
<td>TYP</td>
</tr>
<tr>
<td>MIN</td>
<td>I_F</td>
<td>I_F</td>
<td>MAX</td>
<td>I_C</td>
<td>I_F</td>
<td>MAX</td>
<td>I_F</td>
<td></td>
</tr>
<tr>
<td>OPB 120</td>
<td>0.8</td>
<td>40 (1)</td>
<td>100</td>
<td>0.4</td>
<td>0.4</td>
<td>40</td>
<td>1.5</td>
<td>50</td>
</tr>
<tr>
<td>OPB 242</td>
<td>1.5</td>
<td>40 (1)</td>
<td>100</td>
<td>0.4</td>
<td>0.4</td>
<td>40</td>
<td>1.5</td>
<td>50</td>
</tr>
<tr>
<td>OPB 243</td>
<td>3.2</td>
<td>40 (1)</td>
<td>300</td>
<td>1.1</td>
<td>0.4</td>
<td>50</td>
<td>1.6</td>
<td>50</td>
</tr>
<tr>
<td>OPB 806</td>
<td>0.6</td>
<td>20</td>
<td>100</td>
<td>0.4</td>
<td>0.26</td>
<td>20</td>
<td>1.7</td>
<td>20</td>
</tr>
<tr>
<td>OPB 810</td>
<td>2.0</td>
<td>30 (2)</td>
<td>100</td>
<td>0.6</td>
<td>1.8</td>
<td>40</td>
<td>1.8</td>
<td>40</td>
</tr>
<tr>
<td>OPB 813</td>
<td>0.5</td>
<td>20</td>
<td>100</td>
<td>0.4</td>
<td>0.25</td>
<td>20</td>
<td>1.7</td>
<td>20</td>
</tr>
<tr>
<td>OPB 813S (3)</td>
<td>0.5</td>
<td>20</td>
<td>100</td>
<td>0.4</td>
<td>0.25</td>
<td>20</td>
<td>1.7</td>
<td>20</td>
</tr>
<tr>
<td>OPB 814</td>
<td>1.0</td>
<td>10 (2)</td>
<td>100</td>
<td>0.4</td>
<td>0.25</td>
<td>10</td>
<td>1.7</td>
<td>20</td>
</tr>
<tr>
<td>OPB 815</td>
<td>1.8</td>
<td>20 (2)</td>
<td>100</td>
<td>0.8</td>
<td>1.8</td>
<td>20</td>
<td>1.7</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes:
(1) V_CES=5 V
(2) V_CES=0 V
(3) Response time measured with I_C=0.8 mA
(4) V_CES=5 V
(5) V_CES=30 V
(6) Sensor aperture diameter to 0.010 x 0.008 inches

CASE 21

CASE 22

CASE 23

CASE 24

CASE 25

NOTES:
1. All dimensions are in inches.
2. All tolerances are ±0.010 unless otherwise specified.
3. Parts with circuit symbol noted on case may be used.
4. Parts with circuit symbol noted on case may be used.
5. Parts with circuit symbol noted on case may be used.
6. Parts with circuit symbol noted on case may be used.
7. Parts with circuit symbol noted on case may be used.
8. Parts with circuit symbol noted on case may be used.
9. Parts with circuit symbol noted on case may be used.
10. Parts with circuit symbol noted on case may be used.
11. Parts with circuit symbol noted on case may be used.
12. Parts with circuit symbol noted on case may be used.
13. Parts with circuit symbol noted on case may be used.
14. Parts with circuit symbol noted on case may be used.
15. Parts with circuit symbol noted on case may be used.
16. Parts with circuit symbol noted on case may be used.