AT/14.7/001

Culgoora Weather station user guide

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Table of Contents

Culgoora Weather Station

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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 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 STARTUP

a). 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). 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 OPTRON optoelectronic chopper (model OPB 804) detects the rotation of the shaft.

The scaling adopted : V (km/hr) = F (hz) * 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 suply.

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/m^2).

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 (mb) = V * 100. + 600. 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.

5 PROGRAMMING THE LOGGER

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:

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

5.2 Definition of the channels to be interrogated.

In ORION terms:

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

5.3 Definition of the calibration algorithms and factors to be applied.

In ORION terms:

CO1 MO SC MC 0.158, 0.837 UN KMH	Conversion routine #1, linear scaling (0.158*x + 0.837), units kmh

```
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 wouyld 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.Paynten 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 '
20 '       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$(8,32)
125 '
130  OPEN "COM1:" AS #1
140 '
150  SKIP = 5
160 '
165   GOSUB 2000        : ' task initioaliser
170   GOSUB 1250        : ' screen initialiser
180 '
190 '
200   FIRST.REC = TRUE
210 '  simple minded loop
220 '
230     MSG$ = " "
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 '
```

```
360 '
370 '             decide if there is anything worth printing
380 '
390  IF (NOT FIRST.REC) GOTO 460
420  MSG$ = " "
430  FIRST.REC = FALSE
440  GOTO 510
450 '
460     GOSUB 660
470     GOSUB 1100
480     MSG$ = " "
490 '
500 '
510   WEND
520 '
521   THIS.HR = VAL (MID$(TIME$,1,2))
522   IF (THIS.HR <> LAST.HR) THEN GOSUB 4000
523 '
524   A$ = INKEY$
525   IF ((A$="Q") OR (A$="q")) THEN GOTO 545
526 '
530 GOTO 210
540 '
542  GOSUB 4000  :'  write a last record
543 '
545  CLS
546   PRINT:  PRINT "   Weather logger stopped"
547   PRINT:
548   PRINT  "data file now has "; N.RECORDS;  "  records"
550 '
555  END
557 '.........................................................
560 '
570 '    SUBROUTINE TO WASTE TIME
580 '
590      J = 0
600     FOR I = 1 TO SKIP
610      J = J + 1
620     NEXT I
630 '
640 RETURN
645 '.........................................................
650 '
660 '    subroutine to parse an input line
670 '
680     PNT = LEN(MSG$)
690     N1 = 1
700     NTERMS = 0
710 '
```

```
720     FOR I = N1 TO PNT
730       IF (ASC(MID$(MSG$,I,1)) > 32) GOTO 770
740     NEXT I
750     GOTO 1080
760 '
770 '
780     N1 = I
790 '                 is this time ?
800 '
810       IF (MID$(MSG$,N1,1) <> "S") GOTO 880
820 '
830         NTERMS = 1
840         POINTS(1) = -1
850          TM.STR$ = MID$(MSG$,N1+6,10)
851          TIME$ = TM.STR$
852          TM.STR$ = TIME$
860         GOTO 1080
870 '
880 '                 ":" ?
890       IF (MID$(MSG$,N1,1) <> ":") GOTO 940
900        N1 = N1 + 19
910        IF (N1 < PNT) GOTO 940
920        GOTO 1080
930 '
940       IF (MID$(MSG$,N1,1) <> "C") GOTO 1030
950         NTERMS = NTERMS + 1
960         PT = VAL(MID$(MSG$,N1+2,3))
962         POINTS(NTERMS) = PT
964         IF ((PT>0) AND (PT<6)) THEN POINTS(NTERMS) = 1
970          V.DATA(NTERMS) = VAL(MID$(MSG$,N1+6,7))
980        N1 = N1 + 20
990        IF (N1 < PNT) GOTO 720
1000 '
1010         GOTO 1080
1020 '
1030      IF (MID$(MSG$,N1,1) = "D") GOTO 1080
1040       PRINT "possible trouble : "
1050      PRINT MSG$
1070 '
1080     RETURN
1085 '............................................................
1090 '
1100 '  Subroutine to describe the values found
1110 '
1120    IF (NTERMS = 0) GOTO 1220
1130     FOR I = 1 TO NTERMS
1140      IF (POINTS(I) = -1) GOTO 1200
1150       A1 = A.NDX(POINTS(I)) :  B1 = B.NDX(POINTS(I))
1160       LOCATE A1,B1 :  PRINT BLANK$
```

```
1170     LOCATE A1,B1:  PRINT USING "######.#"; V.DATA(I)
1172     J = INDX(POINTS(I))
1175     GOSUB 7000          : ' update the data
1180     GOTO 1210
1190 '
1200     LOCATE 6,33:  PRINT TM.STR$
1210   NEXT I
1220 '
1230  RETURN
1235 '..............................................................
1240 '
1250 ' subroutine to initialise the screen
1260 '
1270  CLS
1280  LOCATE 2,10
1290   PRINT "Culgoora weather station and logger  -   jan6/88 version"
1300 '
1310  LOCATE 3, 60
1320   PRINT DATE$
1330 '
1340  LOCATE 6, 5
1350   PRINT "time of last data sample : "
1360 '
1370  LOCATE 8, 1 :  PRINT "wind speed : "
1383  LOCATE 8, 25:  PRINT "k/hr"
1385  A.NDX(1) = 8:  B.NDX(1) = 15
1390  A.NDX(2) = 8:  B.NDX(2) = 15
1400  LOCATE 8, 40:  PRINT "wind direction : "
1410   LOCATE 8,70:  PRINT "degs"
1420  A.NDX(67) = 8:  B.NDX(67) = 60
1430 '
1440  LOCATE 11,1
1450   PRINT "ground temp : "
1455  LOCATE 11, 25:  PRINT "C"
1460  A.NDX(61) = 11:  B.NDX(61) = 15
1470  LOCATE 11, 40
1480   PRINT "10m temp : "
1485  LOCATE 11, 70:  PRINT "C"
1490  A.NDX(63) = 11:  B.NDX(63) = 60
1500 '
1510  LOCATE 14,1
1520   PRINT "precipitation : "
1525    LOCATE 14,25:  PRINT "mm"
1530   A.NDX(21) = 14:  B.NDX(21) = 15
1540  LOCATE 14, 40
1550   PRINT "humidity : "
1555  LOCATE 14, 70 : PRINT "%"
1560  A.NDX(70) = 14:  B.NDX(70) = 60
1570 '
```

```
1580 LOCATE 17,1
1590  PRINT "pressure : "
1595  LOCATE 17,25 :  PRINT "mb"
1600  A.NDX(69) = 17:  B.NDX(69) = 15
1610  LOCATE 17, 40
1620  PRINT "sol. rad : "
1625  LOCATE 17, 70 : PRINT "W/sqm"
1630  A.NDX(68) = 17:  B.NDX(68) = 60
1640 '
1645  LOCATE 20,1 :  PRINT "room temp : "
1647  LOCATE 20, 25: PRINT "C"
1650  A.NDX(65) = 20:  B.NDX(65) = 15
1670  LOCATE 22,1
1680 PRINT "Last record at "; TM.LOG$;
1682 PRINT "    there are now "; N.RECORDS; " records on disk"
1685  PRINT " This task started on "; STRT.DATE$;
1687  PRINT "    at "; STRT.TIME$
1690 '
1692  LOCATE 25,1
1693  PRINT "Type Q to halt task";
1700  RETURN
1705 '..........................................................
1999 '
2000 '   Subroutine to initialise the various arrays
2010 '
2030 '
2040     STRT.DATE$ = DATE$
2045     STRT.TIME$ = TIME$
2050 '
2060     GOSUB 3000    : '  zeroes the data array
2070 '
2080     INDX(1) = 1   : ' wind speed
2090     INDX(2) = 1   : ' wind speed
2100     INDX(21) = 6  : ' precipitation
2110     INDX(61) = 3  : ' ground level temperature
2120     INDX(63) = 4  : ' 10 m temp
2130     INDX(65) = 5  : ' room temperature
2140     INDX(67) = 2  : ' wind direction
2145     INDX(68) = 9  : ' solar radiation
2150     INDX(69) = 7  : ' pressure
2160     INDX(70) = 8  : ' humidity
2170 '
2180     LAST.HR = VAL (MID$(TIME$,1,2))
2200 '
2210     OPEN "b:records.dat" FOR INPUT AS #3
2220       INPUT #3, N.RECORDS
2230     CLOSE #3
2240 '
2280 RETURN
```

```
2285 '..............................................................
2999 '
3000 ' Subroutine
3010 '                  zeroes the data array
3020   FOR I = 1 TO 2
3030     FOR J = 1 TO 6
3040       ARR.DAT(J,I) = 0!
3045       IF (J=3) THEN ARR.DAT(J,I) = 1000000!
3050     NEXT J
3060   NEXT I
3070 '
3080   FOR I = 1 TO 9
3090     FOR J = 4 TO 6
3100       ARR.DAT(J,I) = 0!
3110     NEXT J
3120   NEXT I
3130 '
3135    ARR.DAT(5,3) = 1!
3136    ARR.DAT(5,4) = 1!
3140 '
3180 RETURN
3185 '...........................................................
3999 '
4000 '  Subroutine to log data to disk
4010 '
4020   OPEN "b:weather.dat" FOR APPEND AS #2
4030 '
4040   TM.LOG$ = TIME$
4050 '
4060   PRINT #2, TM.LOG$, DATE$
4070 '
4080 '  gather the statistics
4090 '                    wind
4100   J = 1
4110   GOSUB 5000
4120 '
4130 '                    wind direction
4140   J = 2
4150   GOSUB 6000
4160 '
4170   J = 3              : ' ground temp
4180   GOSUB 5000
4190 '
4200   J = 4              : '  10 m temp
4210   GOSUB 5000
4220 '
4222   J = 7              : '  pressure
4224   GOSUB 5000
4226 '
```

```
4230  J = 8            :' humidity
4240  GOSUB 5000
4250 '
4251  J = 9          :' INSOLATION
4252  GOSUB 5000
4253 '
4260   PRINT #2, ARR.DAT(4,1), ARR.DAT(5,1), ARR.DAT(2,1),
                     ARR.DAT(3,1)
4270   PRINT #2, ARR.DAT(2,2), ARR.DAT(4,3), ARR.DAT(4,4),
                     ARR.DAT(4,7)
4280   PRINT #2, ARR.DAT(1,6), ARR.DAT(4,8), ARR.DAT(4,9)
4290 '
4300  CLOSE (2)
4310 '
4315   GOSUB 9000    :'  update record number counter
4317 '
4320   GOSUB 3000 : '   zero the data arrays
4330 '
4340   GOSUB 1250 : '   refresh the screen
4350 '
4360   LAST.HR = THIS.HR
4370 '
4390 '
4400  RETURN
4405 '...............................................................
4999 '
5000 '  subroutine
5010 '          generate the statistics
5020 '
5030   WEIGHT = ARR.DAT(6,J)
5040  IF (WEIGHT = 0) GOTO 5150
5050 '
5060   MEAN = ARR.DAT(4,J) / WEIGHT
5070 '
5080   RMS  = ARR.DAT(5,J) / WEIGHT - MEAN*MEAN
5090  IF (RMS < 0) GOTO 5160
5100   RMS = SQR (RMS)
5110  GOTO 5200
5120 '
5150 '        problems
5160  RMS = 0!
5170 '
5200   ARR.DAT(4,J) = MEAN
5210   ARR.DAT(5,J) = RMS
5220 '
5230 RETURN
5235 '...............................................................
5999 '
6000 '   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.DATA(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)*T.FACT + DATUM
7715   ARR.DAT(6,J) = ARR.DAT(6,J) + ARR.DAT(5,J)
7720   ARR.DAT(5,J) = ARR.DAT(5,J)*T.FACT
7725 '
7800 RETURN
7805 '...............................................................
7999 '
8000 '    subroutine to evaluate ATAN2D
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 '
30 '      Weather data analysis
40 '
50 '      mjk, 7/jan/88
60 '
70 '.....................................................
80 '
90        DIM ARR.DAT(11), WANT(11), L.TITLE$(11), L.UNIT$(11)
100 '
110       FALSE = 0 :  TRUE = NOT FALSE
120 '
130       KEY OFF
140 '
150       GOSUB 2290  :'        initialise titles
160 '
170       CLS :  LOCATE 5,5
180        INPUT " Enter data filename : ", IN.FIL$
190 '
200       OPEN IN.FIL$ FOR INPUT AS #1
210 '
220       LOCATE 7,5 :  PRINT " Patience while we read the file "
230 '
240 '
250 '                find the first record
260 '
270       N.LINE = 0
280       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 '
330       GOSUB 960              :' read the 3 lines of the first record
340 '
350       N.REC = 1
360       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 '
430       CLOSE #1
```

```
440 '
450 '
460       P.DATE$ = "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.DATE$) GOTO 680
630 '
640       GOSUB 1050            :' read and print the data
650       FOUND = TRUE
660      GOTO 710
670 '
680       IF (FOUND) GOTO 730       :' can quit
690 '
700       GOSUB 960             :' skip 3 lines
710       WEND
720 '
730 '
740       PRINT
750 '
760        IN.MSG$ = "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
```

```
910      PRINT " No time stamp found"
920      PRINT " Is "; IN.FIL$; "  the correct filename?"
930     PRINT
940     STOP
950 '.......................................................
960 '       subroutine
970 '                   reads 3 lines, no data resulting
980 '
990         LINE INPUT #1, C1$
1000        LINE INPUT #1, C2$
1010        LINE INPUT #1, C3$
1020 '
1030  RETURN
1040 '.......................................................
1050 '      subroutine
1060 '                  reads 3 lines; extracts 10 items
1070 '
1080 '
1090     FOR I = 1 TO 11
1100       IF ((I=11) AND (L.DATE$<"01-08-1988")) GOTO 1120
1110       INPUT #1, ARR.DAT(I)
1120     NEXT I
1130 '
1140      GOSUB 1180        :' print
1150 '
1160 RETURN
1170 '.......................................................
1180 '     subroutine
1190 '                  prints the required data
1200 '
1210      PRINT MID$(T.MSG$,1,8);
1220      IF (L.PRINT) THEN LPRINT MID$(T.MSG$,1,8);
1230 '
1240     FOR I = 1 TO 11
1250       IF(NOT WANT(I)) GOTO 1300
1260 '
1270         PRINT USING "#####.#"; ARR.DAT(I);
1280         IF (L.PRINT) THEN LPRINT USING "#####.#"; ARR.DAT(I);
1290 '
1300     NEXT I
1310      PRINT " "
1320      IF (L.PRINT) THEN LPRINT " "
1330 '
1340 RETURN
1350 '.......................................................
1360 '      subroutine
1370 '                  options setup
1380 '
1390     CLS
```

```
1400    PRINT " There are "; N.REC; "  records
1410    PRINT
1420    PRINT " from "; F.MSG$
1430    PRINT " to   "; MSG$
1440 '
1450    F.DATE$ = MID$(F.MSG$,15,10)
1460    E.DATE$ = MID$(MSG$,15,10)
1470    IF (NOT FOUND) THEN P.DATE$ = "01-01-1900"
1480 '
1490    LOCATE 6,2
1500    INPUT "Enter date to list (mm-dd-yyyy) : ", L.DATE$
1510    IF ((L.DATE$>=F.DATE$)AND(L.DATE$<=E.DATE$)) GOTO 1560
1520      ERR.MSG$ = "Date not on file"
1530     GOSUB 2680
1540     GOTO 1490
1550 '
1560    LOCATE 8,2
1570    IN.MSG$ = "Do you want to change the options? "
1580    GOSUB 2160
1590    IF (NOT ANS) GOTO 1830
1600 '
1610    IN.MSG$ = "Do you want to list on the printer? "
1620    GOSUB 2160
1630    L.PRINT = ANS
1640 '
1650     PRINT "Options: Wind speed,rms,max,min"
1660    PRINT "        wind dir, temps (ground level and 10m)"
1670    PRINT "        pressure, precipitation, humidity"
1680    PRINT " numbered 1 to 11"
1690 '
1700    INPUT "Enter number of items to list (<9) : ", L.NUM
1710    IF (L.NUM>9) THEN L.NUM = 8
1720 '
1730    FOR I = 1 TO 11
1740      WANT(I) = FALSE
1750    NEXT I
1760 '
1770    FOR I = 1 TO L.NUM
1780       PRINT "Enter "; I; "th. item number ";
1790      INPUT ": ", J
1800      WANT(J) = TRUE
1810    NEXT I
1820 '
1830    SKIP = TRUE
1835    IF (L.DATE$>P.DATE$) GOTO 1870
1840      CLOSE #1
1850       OPEN IN.FIL$ FOR INPUT AS #1
1855    SKIP = FALSE
1860 '
```

```
1870      P.DATE$ = L.DATE$
1880 '
1890      PRINT
1900      PRINT L.DATE$ : PRINT
1910      IF (NOT L.PRINT) GOTO 1940
1920       LPRINT: LPRINT L.DATE$: LPRINT
1930 '
1940       PRINT "  time   "; : IF (L.PRINT) THEN LPRINT "  time   ";
1950      FOR I = 1 TO 11
1960        IF (NOT WANT(I)) GOTO 1990
1970         PRINT L.TITLE$(I);
1980         IF (L.PRINT) THEN LPRINT L.TITLE$(I);
1990      NEXT I
2000      PRINT " "
2010      IF (NOT L.PRINT) GOTO 2030
2020        LPRINT " "
2030 '
2040      PRINT "        "; : IF (L.PRINT) THEN LPRINT "        ";
2050      FOR I = 1 TO 11
2060        IF (NOT WANT(I)) GOTO 2090
2070         PRINT L.UNIT$(I);
2080         IF (L.PRINT) THEN LPRINT L.UNIT$(I);
2090      NEXT I
2100      PRINT " ":  PRINT
2110      IF (NOT L.PRINT) GOTO 2130
2120        LPRINT " ":  LPRINT " "
2130 '
2140   RETURN
2150 '.......................................................
2160 '     subroutine
2170 '               asks for a yes/no response
2180 '               returns ans (logical)
2190 '
2200      OUT.MSG$ = 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  "
```

```
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$(11) = "  Sun  "
2430 '
2440       L.UNIT$(1) =  "  km/hr"
2450       L.UNIT$(2) =  "  km/hr"
2460       L.UNIT$(3) =  "  km/hr"
2470       L.UNIT$(4) =  "  km/hr"
2480       L.UNIT$(5) =  "  degs "
2490       L.UNIT$(6) = "  C    "
2500       L.UNIT$(7) = "  C    "
2510       L.UNIT$(8) =  "  mbars"
2520       L.UNIT$(9) =  "  mm   "
2530       L.UNIT$(10) =  "  %    "
2540       L.UNIT$(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.MSG$
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     F1 = 0
2840     FOR I = 1 TO N.VAL
```

```
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
```

WIND SPEED SENSOR

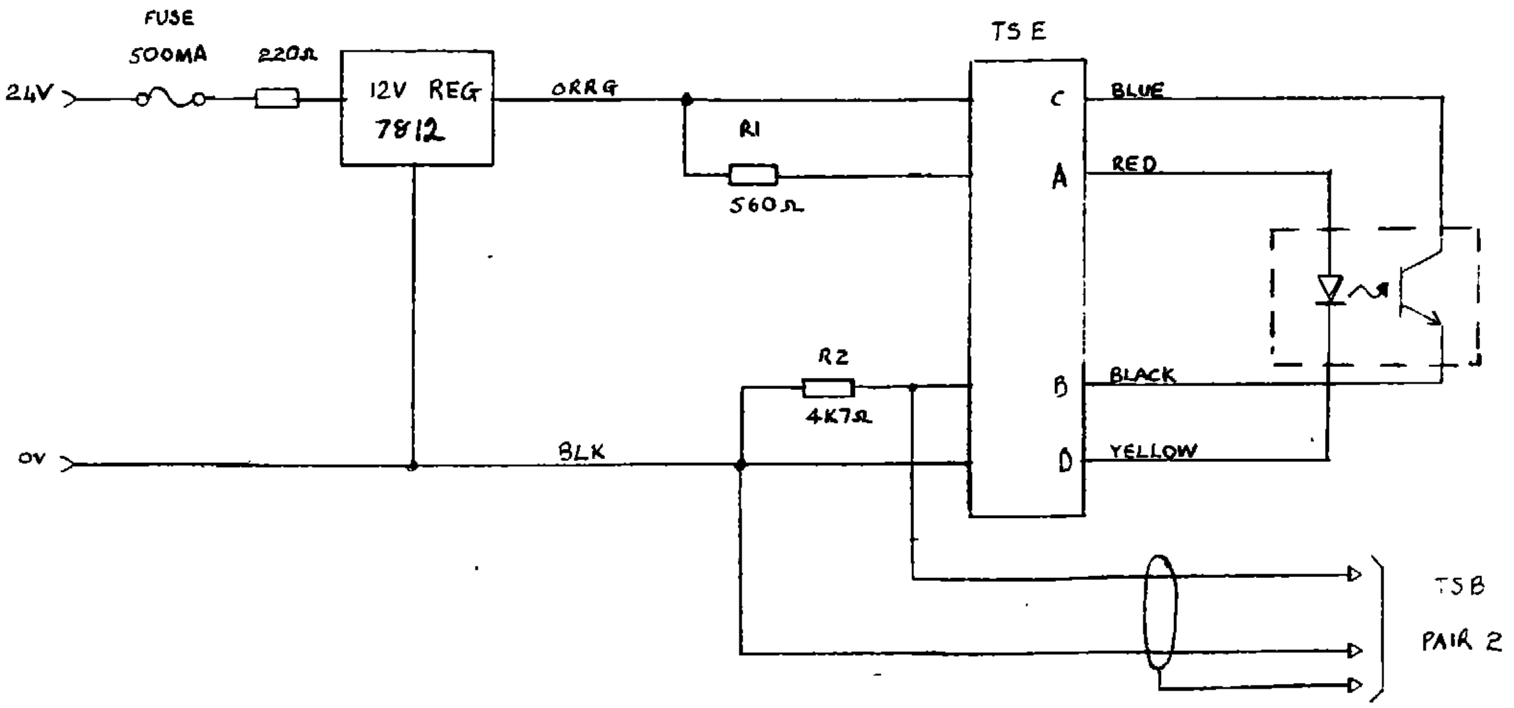


Fig. 1

CULGOORA WEATHER STATION

TOP JUNCTION BOX WIRING (REVISED)

(As Per Wind Direct Change 6/12/85)

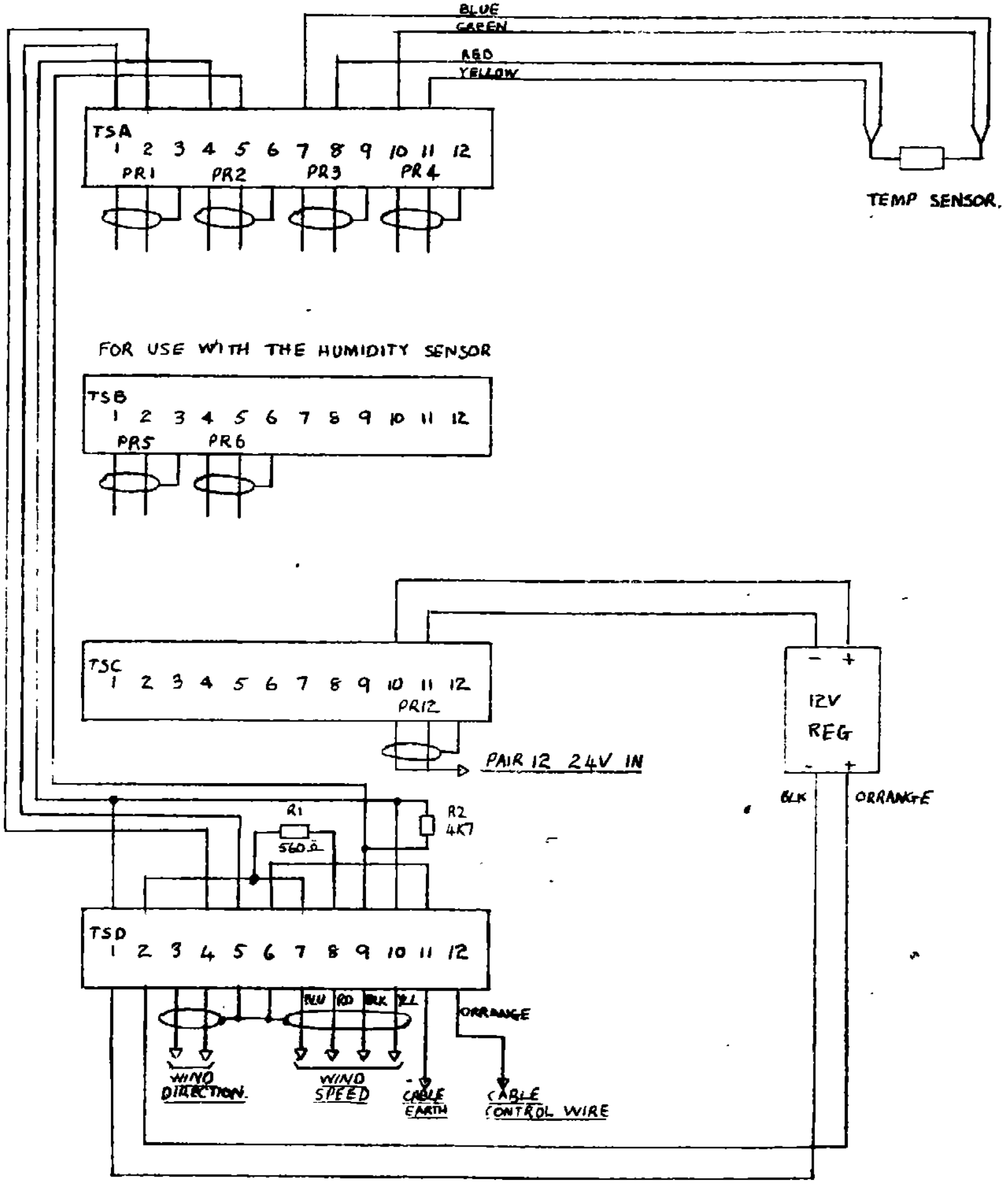
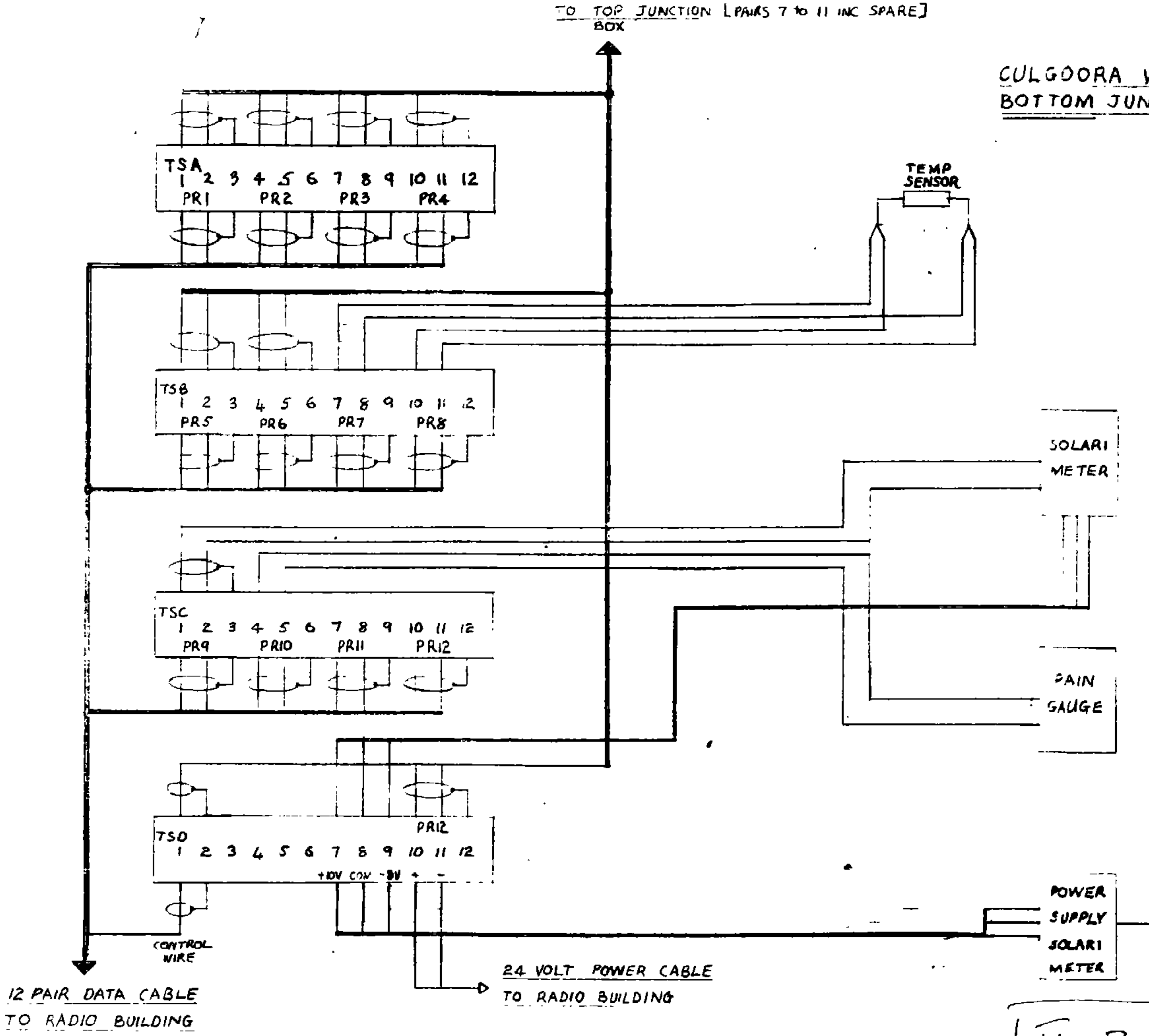


Fig. 2

CULGOORA WEATHER STATION BOTTOM JUNCTION BOX WIRING.



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

Fig. 3

CULGOORA WEATHER STATION

CABLE TERMINATION LOGGER RACK

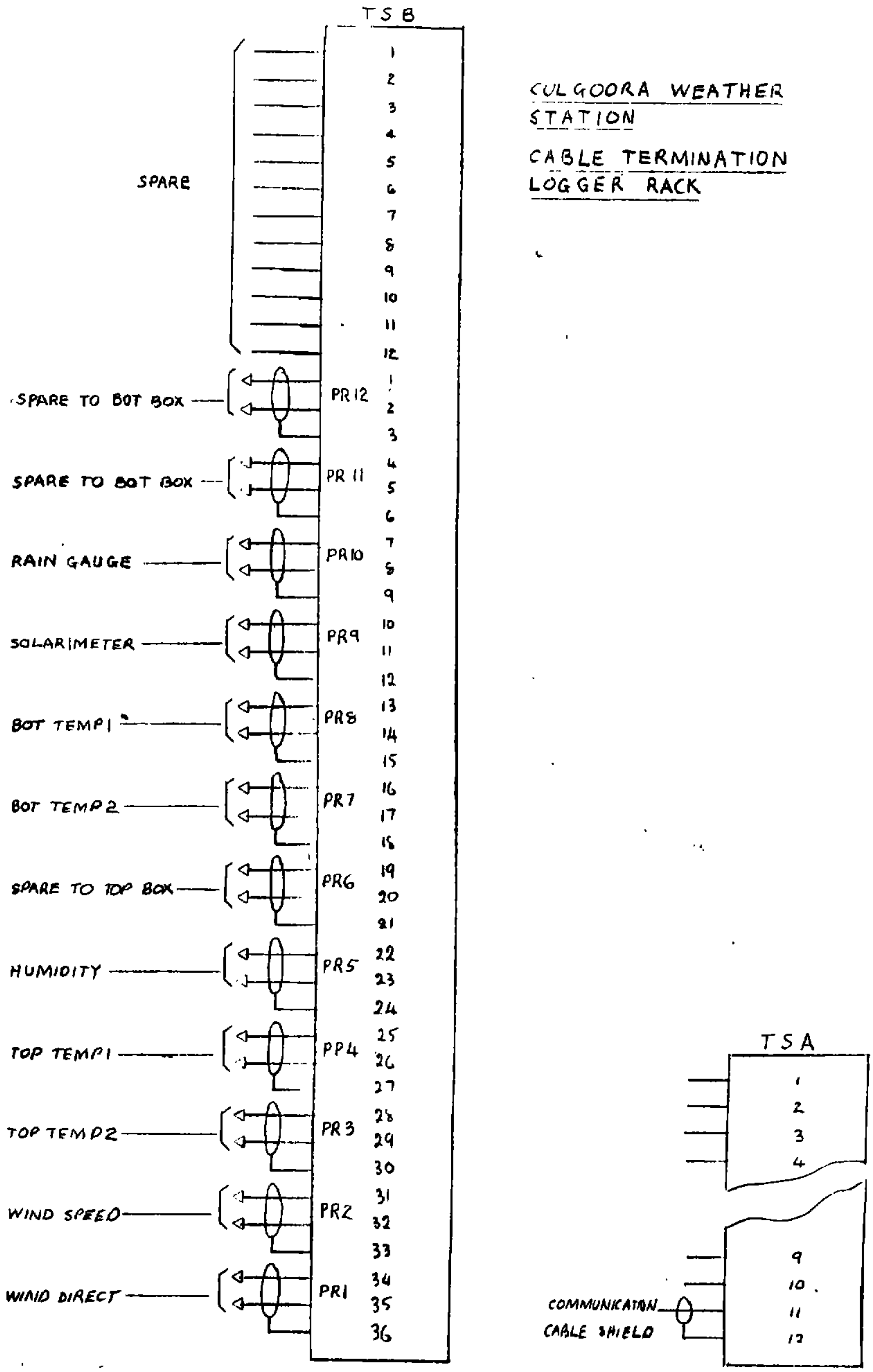


Fig. 4

Counter/ Timer Module.   Slot. 4.   35302 C

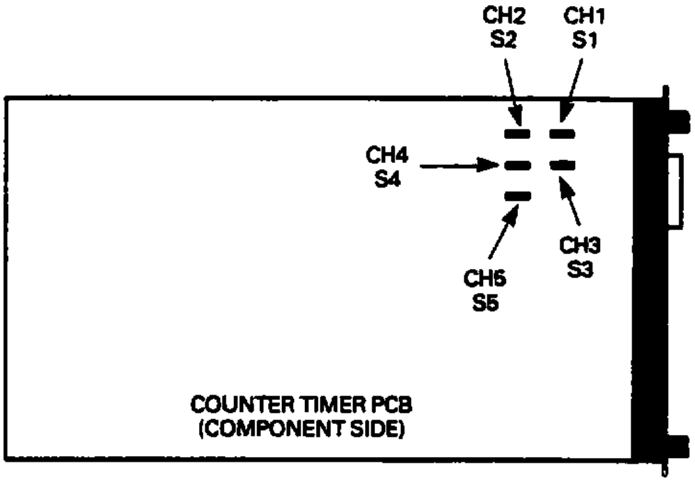
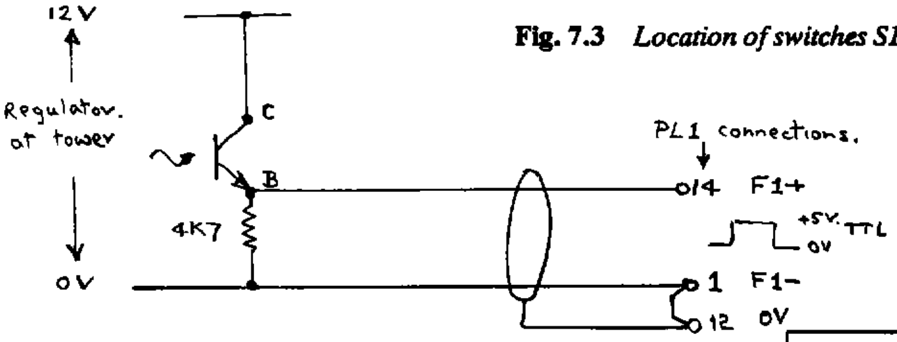
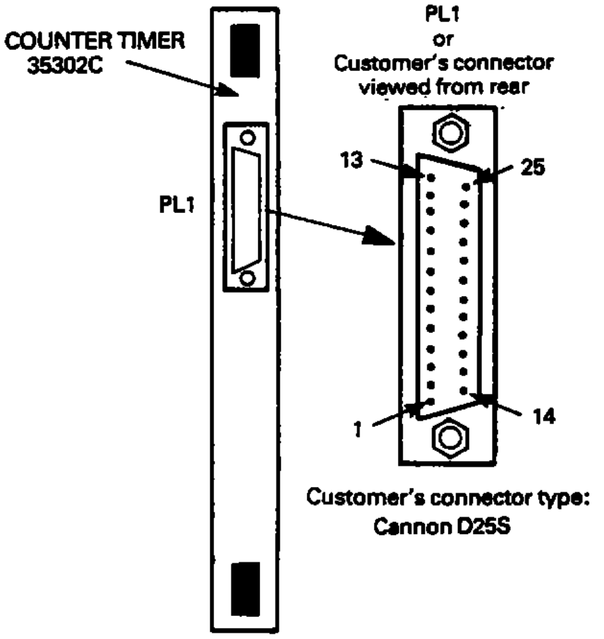


Fig. 7.3 *Location of switches S1–S5*



Channel. 1
WindSpeed.



Customer's connector type:
Cannon D25S

PL1 signals

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

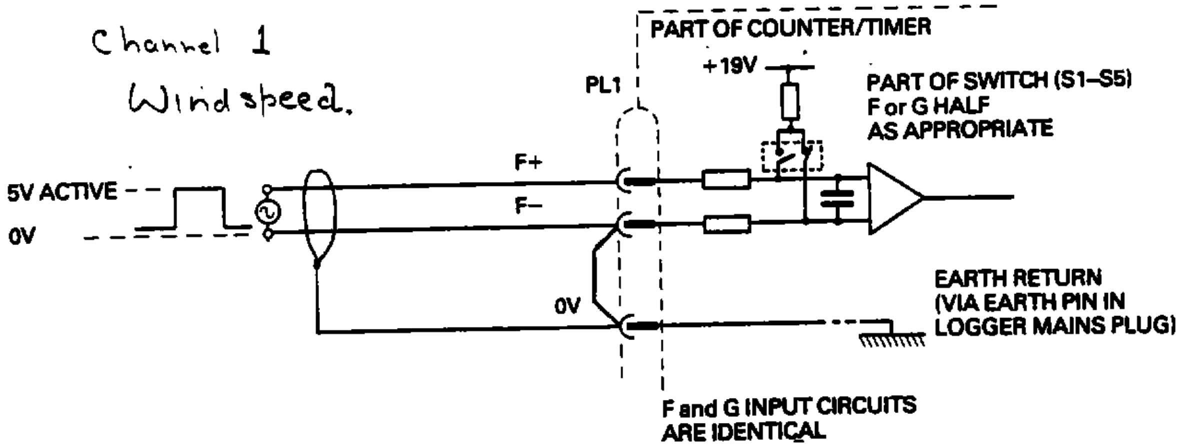
Fig. 5 *PL1 Pin Numbering*

Counter/Timer Module. Slot 4.

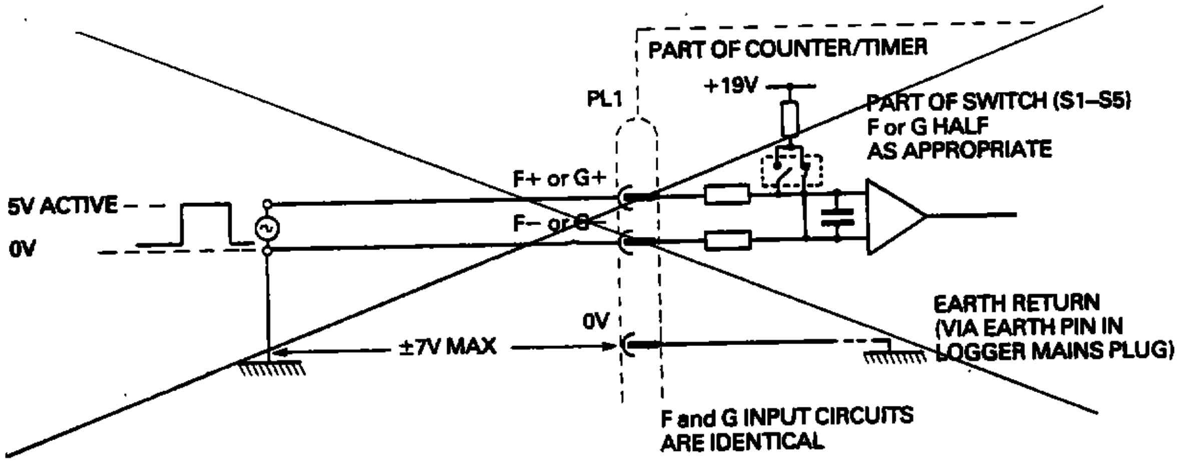
TTL INPUTS: Active Hi

Input connections for a floating signal source

Channel 1
Windspeed.



Input connections for an earthed signal source

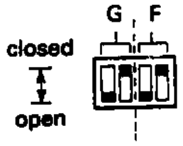


NB THE EARTH RETURN (VIA EARTH PIN IN LOGGER MAINS PLUG) IS ESSENTIAL WHEN NO 0V CONNECTION IS MADE

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

Required Switch Settings.
S1

S1 to S5 RELATE TO CHANNELS 1 to 5 RESPECTIVELY



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)

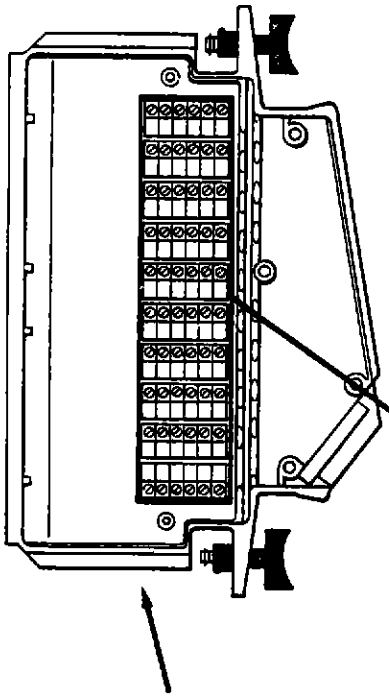
Fig. 6 *TTL Inputs: Active Hi*

20-11-85.

EVENT/STATUS MODULE Slot 5 35302A

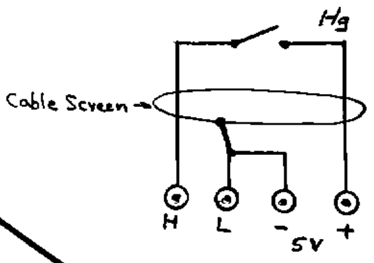
Rain. Gauge. Connections.

EVENT. Recording



INPUT CONNECTOR ASSEMBLY
(COVER PLATE REMOVED)

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



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

DIGITAL CHANNELS

21		5V		22	
H	L	–	+	L	H
23				24	
H	L			L	H
25				26	
H	L			L	H
27				28	
H	L			L	H
29				30	
H	L			L	H
31				32	
H	L			L	H
33				34	
H	L			L	H
35				36	
H	L			L	H
37				38	
H	L			L	H
H	L			L	H
39				40	

NUMBERING

Numbering for channels 1-20 only is shown; subsequent sets of 20 channels are similarly numbered, ie 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.

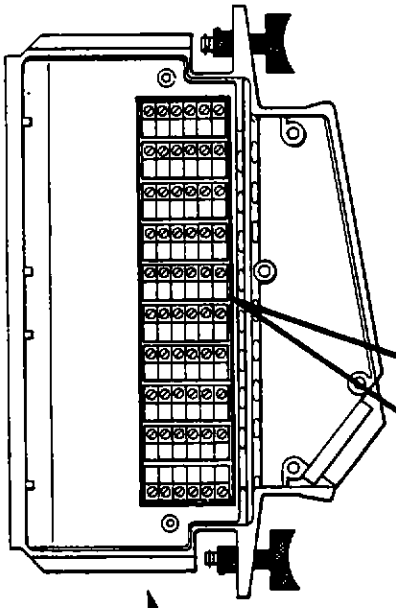
Fig 7 *Input Connector: Channel numbering and pin assignment.*

20-11-85.

Reed Relay Unit. SLot 7. 35301 A.

PRT. Connections.	PRT. Recording.
WinD Direction Connections	Resistance Recording.
Solar Radiation Connections	D.C. Volts. Recording.
Barometric Pressure Connection	DC. Volts Recording.
Relative Humidity Connection	DC. Volts Recording.

H	Hi
L	Lo
G	Guard
I_A	Current Source A
I_B	Current Source B
I_C	Common Current Return
S	Sense



INPUT CONNECTOR ASSEMBLY (COVER PLATE REMOVED)

Channel numbering and pin assignments for 3-pole and 6-pole channels are shown.
In practice, any mix of 3-pole and 6-pole channels on the same input connector is permitted.
Note that 6-pole channels always have odd numbers.
Numbering for Channels 1 to 20 only is shown; subsequent sets of (10 to 20) channels are similarly numbered, i.e. 21 to 40, 41 to 60, and so on up to 181 to 200. Channel numbering on any input connector is dependent on which slot it occupies in the logger mainframe, see Fig 4.4.

3-POLE CHANNELS

	Channel			Channel			
	1			2·			
	H	L	G	G	L	H	
	3			4			
	H	L	G	G	L	H	
	5			6			
	H	L	G	G	L	H	
Wind Direction.	67			68			Solar Radiation.
	H	L	G	G	L	H	
Barometric. Pressure	69			70			Relative Humidity
	H	L	G	G	L	H	
	11			12			
	H	L	G	G	L	H	
	13			14			
	H	L	G	G	L	H	
	15			16			
	H	L	G	G	L	H	
	17			18			
	H	L	G	G	L	H	
	H	L	G.	G	L	H	
	19			20			

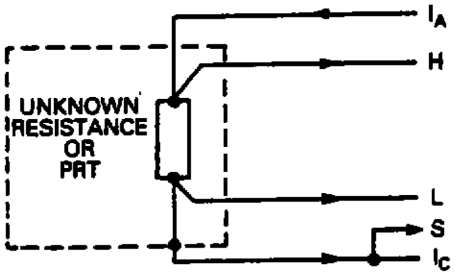
6-POLE CHANNELS

	Channel					
PRT 1	61					
Tower top.	I_A	I_B	I_C	S	L	H
PRT 2.	63					
Tower bot.	I_A	I_B	I_C	S	L	H
PRT 3.	65					
Room temp.	I_A	I_B	I_C	S	L	H
	7					
	I_A	I_B	I_C	S	L	H
	9					
	I_A	I_B	I_C	S	L	H
	11					
	I_A	I_B	I_C	S	L	H
	13					
	I_A	I_B	I_C	S	L	H
	15					
	I_A	I_B	I_C	S	L	H
	17					
	I_A	I_B	I_C	S	L	H
	I_A	I_B	I_C	S	L	.H
	19					

Fig [illegible] *Channel Numbering and Assignment of Terminals on the Input Connectors*

2.5 4-TERMINAL RESISTANCE OR PRT MEASUREMENT

2.5.1 Theoretical Diagram

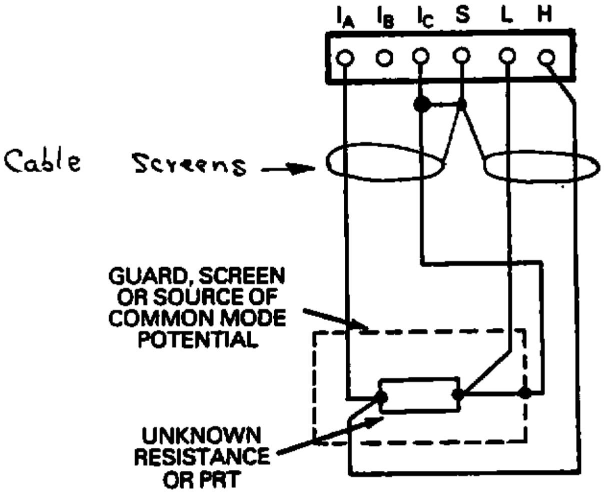


The energising current is generated and switched automatically, no additional linking or connections are required.

Slot 7

2.5.2 Practical Connection Diagram

Connection Diagram for. PRTs.



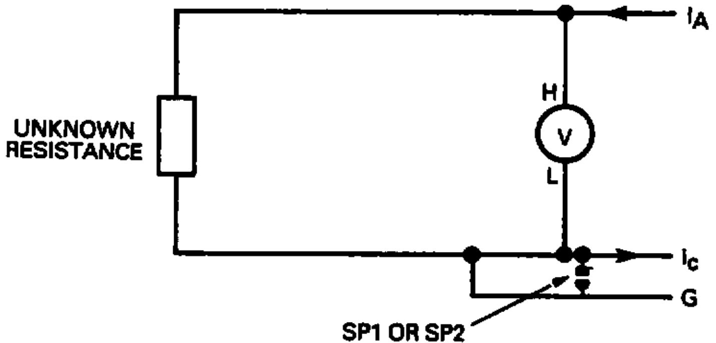
I_A I_B I_C S L H
Cable Screens
GUARD, SCREEN OR SOURCE OF COMMON MODE POTENTIAL
UNKNOWN RESISTANCE OR PRT

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



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

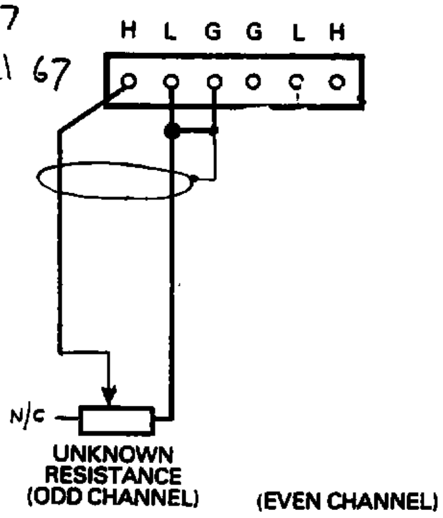
2.4.2 Practical Connection Diagram

Wind Direction. Connection.

Resistance measurment.

Slot 7

Channel 67

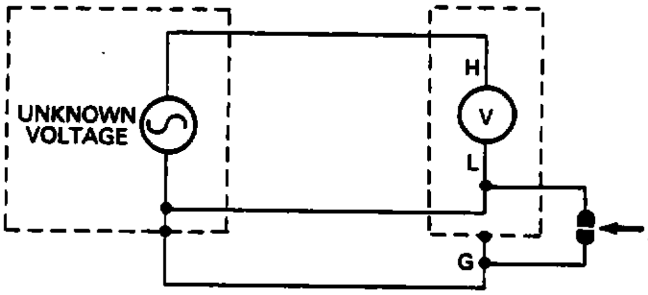


N.B. Use Reed Relay Selector 35301A only. 2-terminal resistance measurement is suitable for applications where less accuracy is required (e.g. measuring 10k to 1% accuracy). For greater accuracy, use 4-terminal resistance measurement, see page 4.24.

Fig. 10

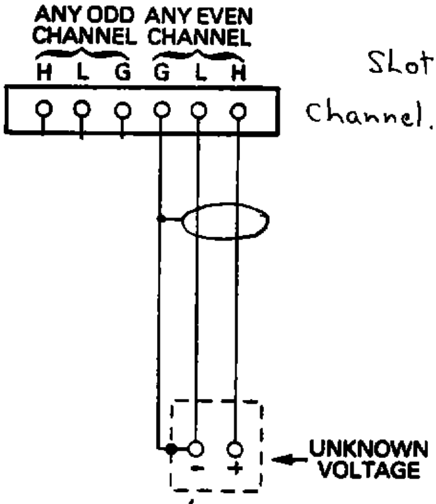
2.2 VOLTAGE MEASUREMENT

2.2.1 Theoretical Diagram



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



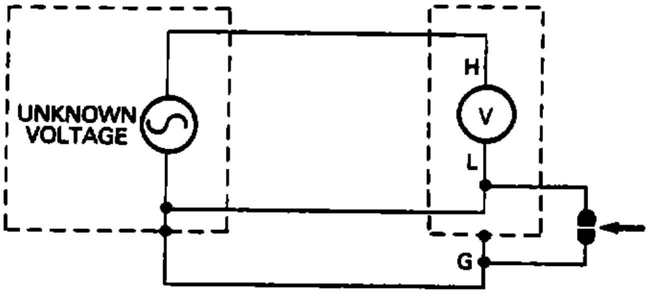
Slot 7
Channel. 68
Solar Radiation.

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. 11

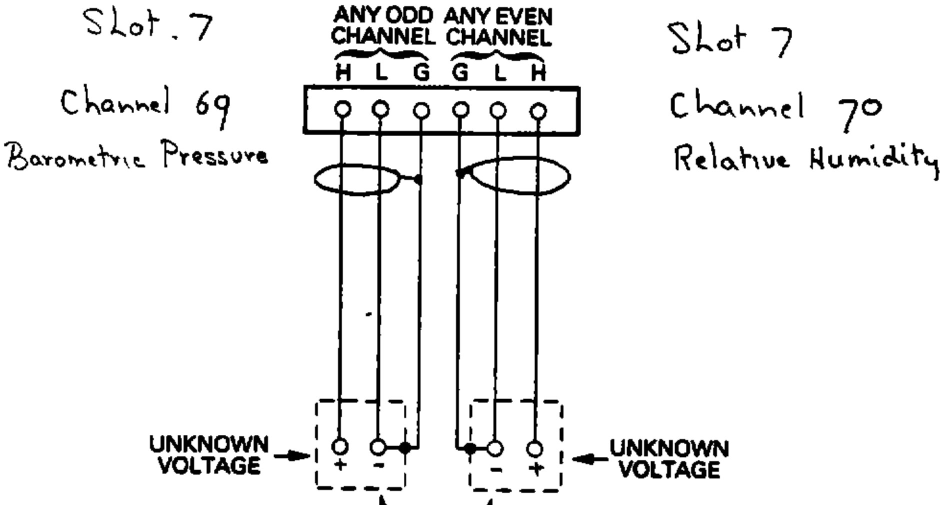
2.2 VOLTAGE MEASUREMENT

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



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

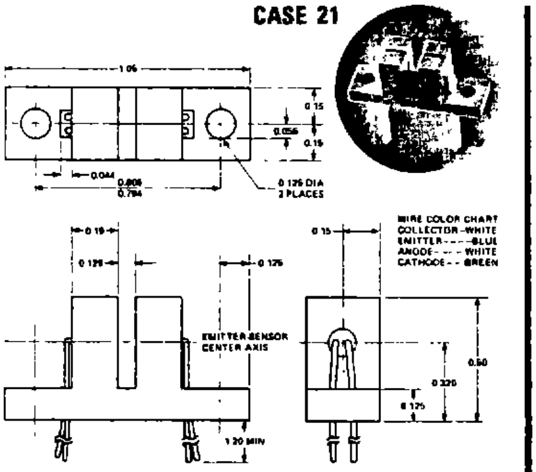
Non-contact switching is provided by OPTRON's optoelectronic interrupter assemblies which consist of a high efficiency gallium arsenide LED and silicon N-P-N phototransistor or photodarlington in a molded plastic housing. A gap in the housing provides a means of sensing motion of opaque objects. Design flexibility is provided by a variety of gap widths and mounting configurations. In addition, units are available with infrared filters to eliminate background illumination and with apertures for high resolution position sensing.

optoelectronic characteristics (25°C)

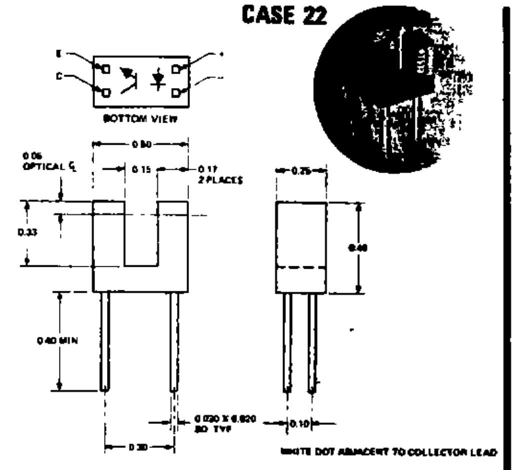
PARAMETER	ON-STATE COLLECTOR CURRENT		OFF-STATE COLLECTOR CURRENT	SATURATION VOLTAGE			LED FORWARD VOLTAGE		RESPONSE TIME	SLOT WIDTH	OUTPUT CONFIGURATION	CASE NUMBER
TEST CONDITION	V_{CE}=10 V I_F as shown		V_{CE}=10 V I_F=0	I_C and I_F as shown			I_F as shown		R_L=100 Ω V_{CC}=5 V I_F=40 mA			
SYMBOL	I_L		I_D	$V_{CE(SAT)}$			V_F		t_r, t_f	d		
UNIT	mA		nA	VOLTS			VOLTS		μsec	INCHES		
	MIN	I_F mA	MAX	MAX	I_C mA	I_F mA	MAX	I_F mA	TYP	NOM		
OPB 120	0.8	40 (1)	100	0.4	0.4	40	1.5	50	2.5 (3)	0.125	Transistor	21
OPB 242	1.6	40 (1)	100	0.4	0.4	40	1.5	50	2.5 (3)	0.125	Transistor	21
OPB 243	3.2	40 (1)	300	1.1	0.4	50	1.6	50		0.125	Darlington	21
OPB 804	0.5	20	100	0.4	0.25	20	1.7	20	5.0	0.150	Transistor	22
OPB 806	1.6	35 (4)	25 (5)	0.5	0.4	15	1.5	15	2.5	0.125	Transistor	23
OPB 810	2.0	30 (1)	100	0.6	1.8	40	1.8	40	5.0	0.200	Transistor	24
OPB 813	0.5	20	100	0.4	0.25	20	1.7	20	5.0	0.125	Transistor	25
OPB 813S (6)	0.5	20	100	0.4	0.25	20	1.7	20	5.0	0.125	Transistor	25
OPB 814	1.0	10 (1)	100	0.4	0.25	10	1.7	20	5.0	0.125	Transistor	25
OPB 815	1.8	20 (2)	100	0.6	1.8	20	1.7	20	5.0	0.125	Transistor	25

Notes
(1) V_{CE}=5 V
(2) V_{CE}=0.6 V
(3) Response time measured with I_C=0.8 mA
(4) V_{CE}=0.5 V
(5) V_{CE}=30 V
(6) Sensor apertured internally to 0.010 x 0.040 inches

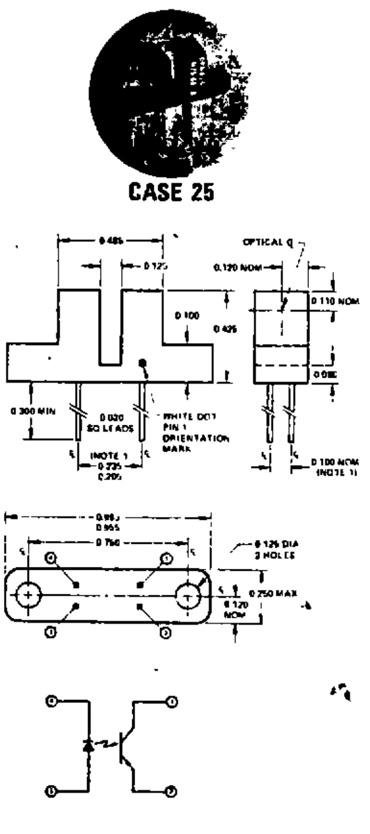
CASE 21



CASE 22

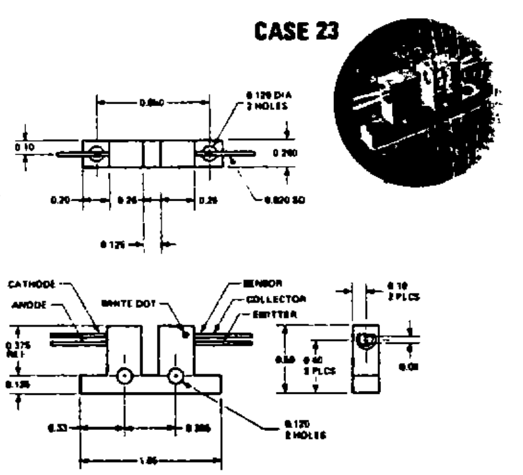


CASE 25

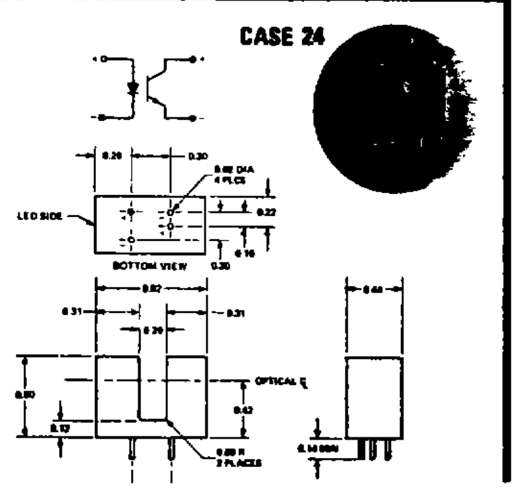


NOTE 1 DIMENSION CONTROLLED AT HOUSING SURFACE ONLY
2 THE PLASTIC HOUSING IS SOLUBLE IN CHLORINATED HYDROCARBONS AND KETONES METHANOL OR ISOPROPANOL ARE RECOMMENDED AS CLEANING AGENTS

CASE 23



CASE 24



ALL DIMENSIONS ARE IN INCHES
.XX = ± 0.010
.XXX = ± 0.005