MONDAY 15TH JUNE, 2009

THIS IS THE CONVERSION DETAILS FOR ADDING THE DIGION BOARD. - HARDWARE INSTALLATION.

TABLE 1A AND 1B REQUIRED TO INSTAL DIGEON BOARD TO 4B (THE COLOUR OF THE DIGION BOARD SHOULD MAINTAIN ORIGINAL FORMAT)

1A AND 1B TABLE AT THE BACK OF THIS HANDBROOK. 2 OF 3.

→ Lloyd

AUSTRALIAN GOVERNMENT
DEPARTMENT OF ADMINISTRATIVE SERVICES

IPS RADIO AND SPACE SERVICES

HANDBOOK 2 of 3

FOR

IONOSONDE TYPE 4D

DIGION CONVERSION FOR IONOSONDE 4B
MANUFACTURED BY THE UNIVERSITY OF AUCKLAND

ISSUED

SEPTEMBER 1995

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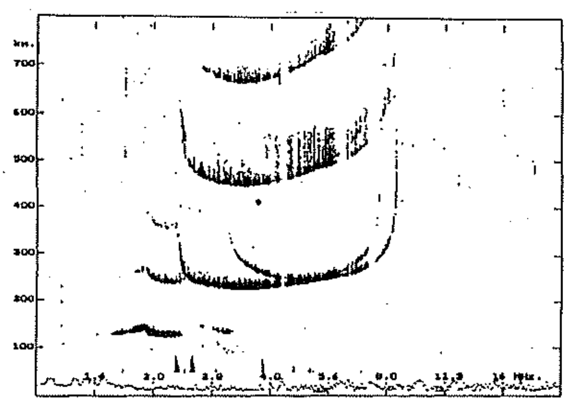

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1. INTRODUCTION

The Digion unit is manufactured by the University of Auckland, Physics department, as an add on to the KEL IPS-42, a commercial version of the IPS 4B, ionosonde. The aim of the Digion conversion is to remove the need to use film to record the ionograms on the 4B ionosonde and replace this ionogram recording with a personal computer. IPS Radio and Space Services commenced installing Digion units in 1993 and has now converted all of its 4B ionosondes. IPS has taken the Digion concept a step further with a number of software improvements and the introduction of a UNIX based personal computer to allow the relay of ionograms to IPS head office.

The Digion conversion consists of a small printed circuit board assembly fitted to the rear of the 4B ionosonde and an expansion card placed inside the personal computer. Only a few wires need to be connected to the ionosonde and only one of these is soldered. A screened cable carries the data and control signals between the personal computer and the ionosonde. There are no actual modifications to the ionosonde so if the Digion unit fails operation of the ionosonde in the conventional, film, mode is possible.

In operation the ionograms are displayed and archived on the personal computer. The use of a computer for this display allows the use of software which can remove noise from the ionograms and therefor improve their appearance.

2. HARDWARE

The 4B ionosonde is already, in essence, a digital instrument. Sounding occurs at a fixed sequence of 576 frequencies, logarithmically spaced from 1.0 to 22.6 MHz and set by a frequency synthesiser. The ionosonde pulses 3 times on each frequency. Echoes are detected, using a comparator which gives a logical 1, when the amplitude of the returned echo exceeds the mean noise level by a fixed amount, and 0 otherwise. This binary signal is clocked into a shift register at a rate which stores the data from the first 800 km of effective height. The data is re-circulated during the 2nd and 3rd soundings, on the same frequency, to zero any bits which do not respond to a consistent return. This method helps remove the effects of atmospheric interference. The result is then passed to the video display during a fourth (quiet) interval. For computer acquisition this final data stream and the associated clock signals must be intercepted.

Figure 1 shows a block diagram of the basic Digion system. A small printed circuit board is added to the rear of the 4B ionosonde, drawing its power (about 1 Watt) from the ionosonde. Five signal leads from this board are clipped to the wire wrap edge connectors in the backplane of the ionosonde, to extract the Data, Clock, Scan, Xmr (transmitter on) and Yb (display blanking) signals. As shown in figure 1, the Scan, Xmr and Yb signals are combined to give a single control line which contains all the necessary timing information. A "minute" signal is also extracted, so that the computer can synchronise itself to the ionosonde clock. One further lead is soldered to the "Monitor Sweep" push-button inside the ionosonde. This connection is used by the computer to initiate a sweep when required.

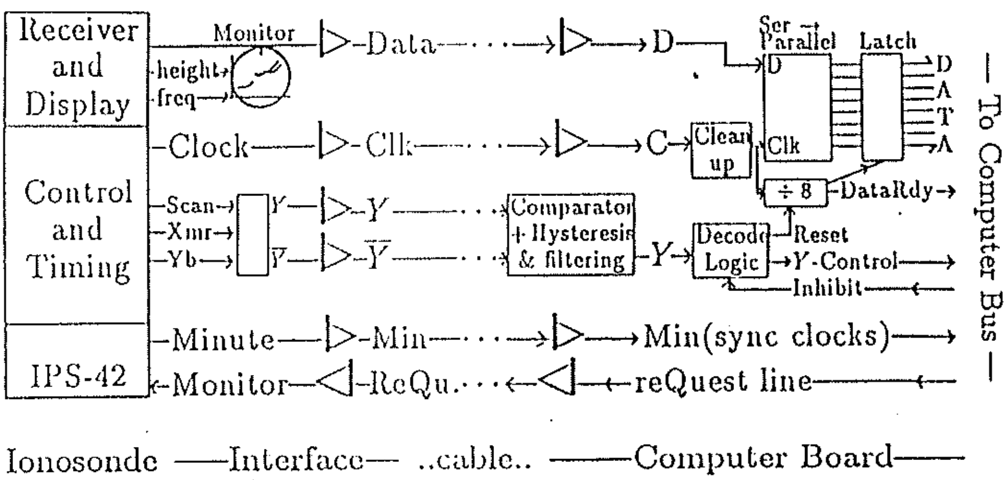


FIG1. Block Diagram Showing the signals extracted from the IPS 4B, the general processing, and the signals connected to the computer bus (all fully buffered). Note. Triangular symbols indicate RS-232 drivers and receivers..

Standard RS-232 drivers are used to feed the ionosonde signals to a cable, which may be many metres long, connected to the computer. In the computer is an added interface card, containing in essence the circuitry on the right of Figure 1. The critical Y-control line is fed to the computer in both true and complimentary form, to reduce noise. These two lines are processed by a circuit which records the transition (in a single Y output) only if both lines switch simultaneously over at least 75% of their full range. This completely avoids common mode interference from the transmitter pulses. A monostable is also used to eliminate rapid transitions. As a final safeguard, the computer keeps track of when the transmitter is on and disconnects the Y signal at these times (using the 'inhibit' line in Figure 1.) These precautions make the system fully immune to interference of any sort.

Data and Clock lines from the ionosonde enter the computer through RS-232 receivers (with added hysteresis), and the Clock is cleaned up to remove any noise pulses. The Data line is then clocked into a serial to parallel converter, and a 'Data Ready' signal is activated when a full byte is available (in latched register) to be read by the computer. The decoded Y signal is used to synchronise data collection with the transmitter pulses. 64 bytes are read by the computer at each frequency. This gives data bytes at each of the 512 heights in the range 0 to 800 km, for a height resolution of 1.56 km.

Within the computer a routine is used to monitor the 'Data Ready' signal, and collect the 64 bytes of data at each frequency. After each byte the computer ignores further signals until the next byte is almost due. After 64 successive bytes, the program again shuts down (to avoid RFI) until just before the time when data should be becoming available at the next frequency. This process is repeated until height scans have been collected at each of the 576 frequencies used by the 4B ionosonde. The ionogram is then displayed while the program waits for the next scheduled recording time.

3. DATA COLLECTION and STORAGE

When the computer is switched on (or reset) it connects to the ionosonde, and waits for a one-minute time signal. This is used to readjust the computer's clock to agree with the ionosonde. Synchronisation is also carried out after the first ionogram in each hour, so that the poor long-term accuracy of the typical computer clock is replaced by the good time-keeping of the 4B. Collection of digital data uses only the 'monitor' display on the ionosonde, and runs in parallel with any film program. Thus Independant data sets may be obtained. Additional ionograms may be obtained at any time by pressing the 'Enter' key on the computer keyboard.

Storage requirements are reduced by 'cleaning' the ionograms before they are compacted. This involves removing the date and time numerals, all information below 75 km and all graticules apart from 4 reference marks which serve to verify the frequency and height scales.. Normally data outside the range 1.3 to 16 MHz is also deleted. Hourly ionograms are left uncleaned to provide a full check on ionosonde operation, including the AGC trace. The actual ionograms recorded and the amount of information saved can be set on the command line at run time.

4. DIGION OPERATING INSTRUCTIONS

The software for the Digion software consists of two programs. These are :-

GETION.EXE: This is the program which operates the Digion unit and collects the ionograms. This program can be run interactively or from a batch file. The normal case is in a batch file called ION.BAT

DIGION.EXE: This program is used to review or scale ionograms on the DOS PC.

The batch file ION.BAT is used to run the Digion unit. This batch file calls the GETION.EXE program and carries out the data archiving. this batch file is also used to transfer the raw files, once a day, from the DOS PC to the UNIX control computer. The AUTOEXEC.BAT file has an entry to allow the ION.BAT file to be called after a reboot so that the GETION.EXE program will restart and ionogram acquisition will continue. Refer to appendix A for the ION.BAT file used on IPS (Antarctic) installations.

The command which does all the work is "getion 5 0".

Getion.exe has the following options:-

GETION m o n

m is the number of minutes between soundings.

o is the offset from on the hour soundings. If 0 then the soundings will start on the hour and continue at m minute intervals. This can be used to avoid sounding on the hour where a sounding may interfere with HF communications.

n is an optional item and this controls which ionograms are cleaned.
If n=0 (the default) then all ionograms except the hourly ionograms are cleaned. This is done to save disk space.
If n= -1 then all ionograms are cleaned.
If n= 1 then no ionograms are cleaned and the standard 4B time and date information is shown on all ionograms.
If n > 1 then every nth ionogram is uncleaned starting with the ionogram nearest to the hour.

In the normal ION.BAT we have GETION 5 0. This means that an ionogram will be taken at 5 minute intervals with no offset from the hour. Ionograms will be taken on the hour and will continue at 5 minute intervals.

If there is a desire to review ionograms on the DOS PC this can be done with the DIGION.EXE program. To start this program you can include the file name when the command is issued or it can be entered after the program is running.

Note files are in the form :- mmmyy.dd

mmm = month eg JAN
yy = year eg 95
dd = day eg 15

To review the file JAN95.15 the command DIGION JAN95.15 would be entered.

When the DIGION.EXE program starts and opens a file list you can enter an ionogram number, from the list, or hit the space bar to start at the first ionogram in the file. It is then possible to scroll through the ionograms.

Up/Down arrow keys progress through the file forwards or backwards one ionogram at a time.

Page Up/ Page Down show every 6th ionogram forwards or backwards.

Ctrl Page Up/Page Down two hour steps trough the file are made.

Home/End takes you to the beginning or end of the file.

If you hit a key the program doesn't recognise the error message

ionogram number [or Quit]

To cancel this and resume press enter to return to the ionogram being reviewed.

To exit at any time press the escape key. This brings up the same message

ionogram number [or Quit] Press q to quit the program.

For further information on these programs refer to the manual IPS manual for the Auckland University Digion System, supplied when the Digion was installed.

Appendix A. IPS DOS Control Computer Directories and Batch Files.

Contents of DOS Software Distribution Disk.

Config.sys

Autoexec.bat

Ion.bat

Kermit.ini

Contents of DOS Software Distribution Disc for IPS-4D Digion Control Computer

```
 Volume in drive A is DIGION 4D

Directory of A:\
CONFIG   SYS            495 14-10-94   2:42p
AUTOEXEC BAT            462 06-10-94  12:50p
BIN          <DIR>          11-05-94   8:57p
DIGION       <DIR>          11-05-94   8:57p
DRIVERS      <DIR>          11-05-94   8:57p
ARCHIVE      <DIR>          30-09-94  12:10p
DOC          <DIR>          06-10-94  12:51p
        7 file(s)             957 bytes

Directory of A:\ARCHIVE
        0 file(s)               0 bytes

Directory of A:\BIN

CTCTRL   EXE         11,939 26-01-92   6:48a
TAR      EXE         53,214 26-01-92   6:48a
PKZIP    EXE         32,932 15-03-90   1:10a
PKUNZIP  EXE         22,592 15-03-90   1:10a
KERMIT   EXE        188,972 16-09-91   2:10p
KERMIT   INI            150 14-10-94   2:37p
        6 file(s)         309,799 bytes

Directory of A:\DIGION

ION      BAK            413 30-09-94  12:14p
DIGION   EXE         79,714 12-11-93   2:22p
GETION   EXE            391 30-09-94  12:12p
ION      BAT            802 06-10-94  12:44p
        4 file(s)          81,320 bytes

Directory of A:\DOC

GNUTAR   DOC          5,007 09-08-93   2:17p
KERMIT   DOC        339,269 01-04-90  11:04p
        2 file(s)         344,276 bytes

Directory of A:\DRIVERS

ADAPTEC      <DIR>          11-05-94   8:57p
        1 file(s)               0 bytes

Directory of A:\DRIVERS\ADAPTEC

ASPI4DOS SYS         12,458 23-08-93   3:22a
        1 file(s)          12,458 bytes
```

```
REM ***************************************************
REM *** CONFIG.SYS for IPS-4D DIGION control computer ***
REM ***************************************************

DOS=HIGH,UMB
BUFFERS=15,0
COUNTRY=061,,C:\DOS\COUNTRY.SYS
FCBS=4,0
FILES=30
LASTDRIVE=G

DEVICE=C:\DOS\HIMEM.SYS
REM *** DEVICE=C:\DOS\EMM386.EXE NOEMS HIGHSCAN

DEVICE=C:\DRIVERS\ADAPTEC\ASPI4DOS.SYS /D
DEVICEHIGH /L:1,12048 =C:\DOS\SETVER.EXE
DEVICEHIGH /L:1,44400 =C:\DOS\DBLSPACE.SYS /MOVE
```

```
@ECHO OFF
REM ******************************************************
REM *** AUTOEXEC.BAT for IPS-4D DIGION control computer ***
REM ******************************************************

PROMPT $p$g
SET PATH=C:\BAT;C:\BIN;C:\DOS;C:\DIGION
SET TAPEID=0:4:0
SET TEMP=C:\TMP
SET TMP=C:\TMP

C:\DOS\SCANDISK /CUSTOM
LH /L:0;1,42384 /S C:\DOS\SMARTDRV.EXE
LH /L:1,6400 C:\DOS\DOSKEY

REM *** Start the DIGION control software
CD \DIGION
ION
```

```
@ECHO OFF

REM ********************************************************************
REM *** ION.BAT used to control IPS-4D/Digion.  Version for use with
REM ***    Unix communications processor.
REM ***
REM *** Esc, or >10 resets in 1 day, -> 0 -> end.
REM ***    New day -> 1 (for new file);   5th day -> 2 to save data.
REM ***
REM *** We now archive every day - no distinction between exit status
REM ***    1 and 2 - craigb, 06Oct94
REM ********************************************************************

:Begin
getion 5 0
if errorlevel 2 goto Daily
if errorlevel 1 goto Daily
if errorlevel 0 goto End

:Daily
pkzip -a c:\archive\data ???9?.*
kermit -F C:\BIN\KERMIT.INI SEND ???9?.*
dir/b ???9?.* > file.dat
ctctrl -r
tar -rf /dev/ct -T file.dat
if errorlevel 1 goto Begin
del ???9?.*
goto Begin

:End
ECHO.
ECHO Digion operation halted due to operator abort via ESC key
ECHO or abnormal termination of GETION.
ECHO.
PAUSE
```

```
; ****************************************************
; *** KERMIT.INI for use with IPS-4D DIGION control ***
; *** computer with Unix communications processor.  ***
; ****************************************************
set port com2
set speed 19200
set flow-control rts
set windows 7
set receive packet-length 512
set send packet-length 512
set file type binary
```

Appendix B. Hardware Installation Guide.

Extract from IPS Manual.

INSTALLATION OF INTERFACE BOARD Z-493-11

The interface board supplied has been tested in an operational Ionosonde IPS-4B before despatch.

1. Check the parts received:

   1 x PCB complete
   1 x DB15 socket skirt and mounting hardware
   1 x Set of PCB mounting hardware
   1 x Set of Installation Instructions
   1 x Installation Kit

2. Read the Installation Instructions in full and when conversant with each step of the procedure to be followed to install this interface board, assemble the following test equipment:

   1 x Oscilloscope, 20 MHz or better
   1 x Multimeter
   Hand tools including soldering iron (temp. controlled), wire strippers, screwdrivers (range), side cutters, pliers and adjustable spanner.
   1 x 24 volt, 2 amp regulated power supply is desirable but not essential.
   1 x IPS-4B Technical Manual.

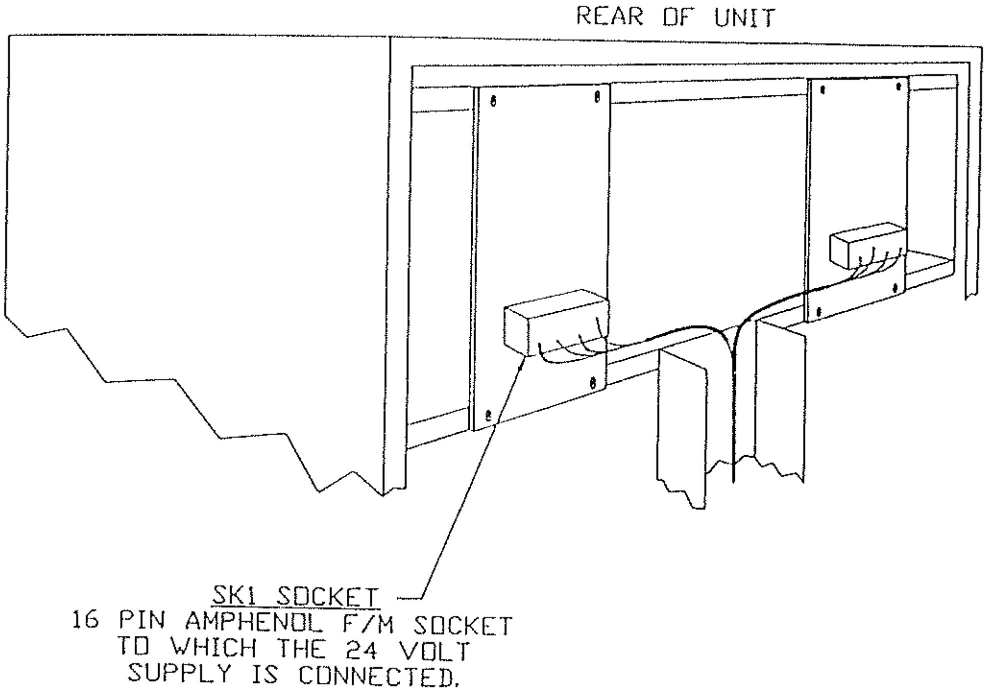
3. Shut down Ionosonde Equipment by disconnecting both the mains power and battery supply.

4. Remove the top chassis (containing the digital plug-in boards) from the main cabinet.

5. Place this chassis on a workbench and verify the position of each "plug-in" board (refer to Table 1B in appendices) that requires connection to the interface board (sight the board numbers, as the boards may not be in numerical order). When found, write the numbers on the chassis frame above each board's socket for future reference. The 33 pin sockets have two rows of wire-wrap pins extending from them. Viewed from the unit's rear, the left hand row holds the odd numbers 1 to 33 (top to bottom) while the right-hand row holds pins 2 to 32. Wire wrapping produces a common loss of some of these pins.

6. Using a 24 volt 2 amp regulated power supply or the power cable in the installation kit connected between your ionosonde's PL1 plus and socket SK1 on the rear of the chassis you now have on your workbench, to supply the unit with power.

Connection of power to the unit must only be made to socket SK1 shown in Figure 1 below:



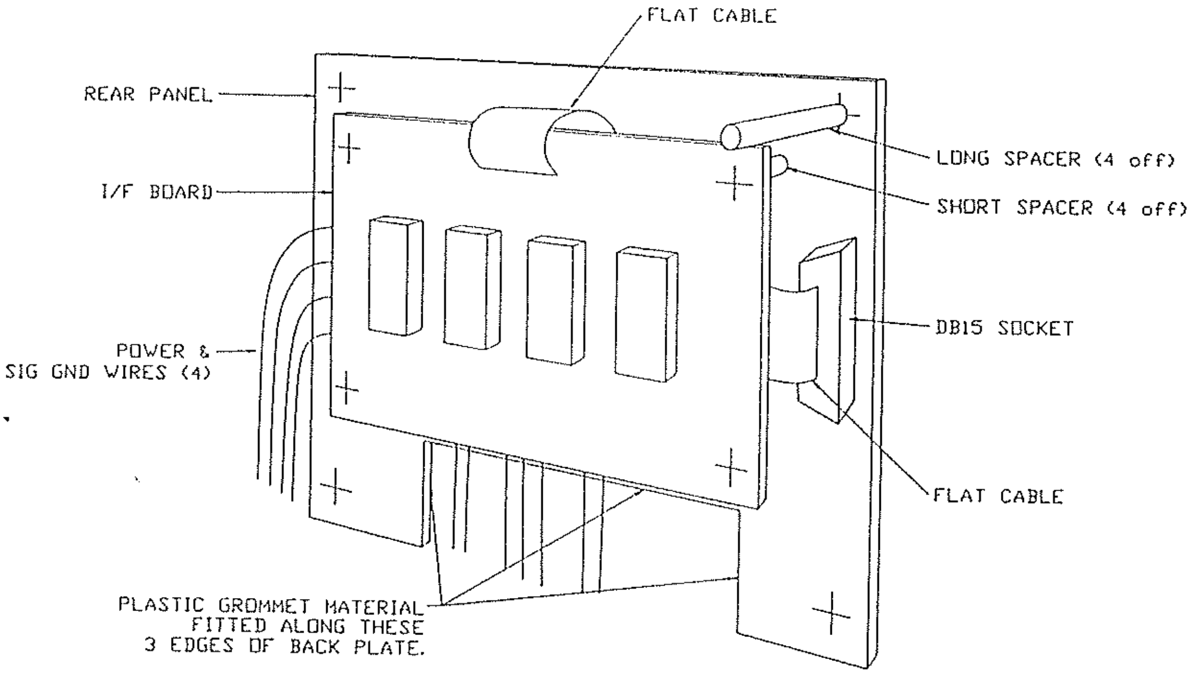
7. Apply power to the unit from either a power supply or your ionosonde via the extension cable from the kit. Now using an oscilloscope, find and verify that the signals to be connected to the interface board are present at the appropriate pins (for pin/signal, wire colour, origin and destination of signal, see Table 1B). Having verified the correct signals are present, switch off and disconnect the power source.

   NOTE:
   The Monitor Single, push-button switch (S3) must be pressed to display some of the waveforms in Table 1B (Monitor Switch S2 set to "Single").

If there is any doubt as to whether or not the correct pin has been identified on a particular board socket, the appropriate circuit diagram in the IPS technical manual should be consulted and the signal path of the pulse/level concerned verified on the unplugged board.

8. Disconnect power to the unit. Then unscrew the left-hand rear cabinet opening (see Figure 1 above) from the chassis, slide along the two cables that pass through it so that it may be placed flat on a workbench without disconnecting these cables. Drill and cut out the aperture for the DB15 socket (see Template) and holes for mounting the socket and interface board from the recommendations in Figures 10 and 11 and templates provided in the appendices.

9. Mount the interface board on the inside of the rear cabinet opening with the flat cable and socket attachment point nearest the top of the cabinet opening (see Figure 2).



Run the flat cable between the interface board and the rear cabinet opening to the DB15 aperture and mount the DB15 socket by first passing it through the slotted aperture before securing it with an RF skirt to the rear cabinet opening.

10. Stand the rear panel upright and secure it to the chassis with two or three screws (finger tight). Fit the nine wires with sockets on their ends from the interface board to the appropriate board socket pin (previously verified from Table 1B). The two remaining wires (grey and black) may now be broken at the "in-line" plug and socket. The sections not connected to the interface board must now be soldered to plug-in board 17, which is mounted on the sub-chassis containing the Main and Monitor rotary switches. This is achieved by removing the sub-chassis from the unit and identifying each test point, to which a wire is to be connected in turn:

(a) the grey wire (monitor request line) is soldered to the test point connected to pin 1 of IC8 and one side of the Monitor pushbutton switch

(b) the black wire (scan level) is soldered to the test point connected to pin 10 of IC7.

Having made these connections, replace the sub-chassis in the "in-line" plugs and sockets for these signals back to the interface board.

11. Re-apply power to the chassis via SK1 and monitor the voltage levels on the interface board which are typically:

+12.1 volts
-12.0 volts
+5.1 volts

If satisfactory, continue (if not, find out why) by testing the signals out of the DB15 socket. These levels and waveforms should be as indicated in Table 2B, remembering that pulses leaving the Ionosonde will be inverted at this socket by the line driving chips.

Remove power from the equipment and reassemble chassis. Reinstate chassis in the equipment cabinet and refit all panels and hooks removed to allow modification to chassis.

To complete the installation, re-apply power to the Ionosonde and check the signal levels/shapes are present at the DB15 output socket.

TABLE 1. THE IONOSONDE INTERFACE BOARD.

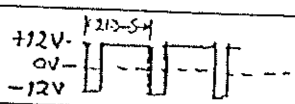
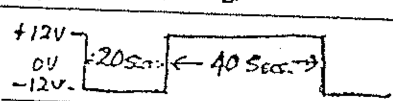
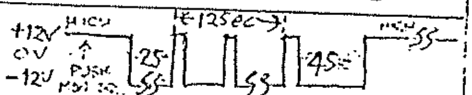
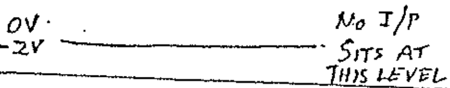
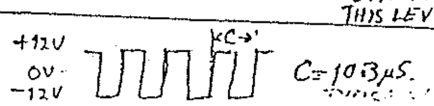
1A. THE POWER CONNECTIONS

+12V	12·12V	BD 18 PIN 3	RED	
-12V	-11·99V	BD 18 PIN 2	BLACK	
+5V	5·06V	BUSS PIN 17	YELLOW	
SIG. GND.	-	BUSS PIN 1	GREEN.	

1B. THE SIGNAL CONNECTIONS

PCB PAD		ORIGIN /DESTINATION	COLOUR	SIGNAL.
1	DATA	BD 8 PIN 18	BLUE	4V, 0V, |←21·3mS→| GATED
2	MINUTE	BD 5 PIN 10	BROWN	4V, 0V, LOW 20S. HIGH 40S.
3	—			
4	—			
5	CLOCK	BD 5 PIN 27	RED	3·4V, 0·3V, |←19μS|
6	—			
7	XMR	BD 8 PIN 31	ORANGE	3·7V, 0·2V, 8Secs 12.5Secs
8	SCAN	BD 17 PIN 30	BLACK	5V, 0V, 19 Secs, PRESS MON. SGL.
9	YB	BD8 PIN 3	WHITE	4V, 0V, ←21·3mS→
10	—			
11	MON. RESET	BD 17, IC8 PIN 1	GREY	HIGH; GOES LOW(0V) ON PRESSING MON. SGL.
12	—			
13	—			

TABLE 2. SIGNALS ON THE DB15 SOCKET

Pin No	Signal	Waveshape.
1	Signal Gnd.	0V.
2	Data	
3	Minute	
4	$\overline{Y}$	
5	Y	
6	Monitor Reqest	
7	Clock	
8	Signal Gnd.	0V.
9 to 15	Signal Gnd	0V