RADIOLINK 20R

TELEMETRY MANUAL

Link Serial No:

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20R TELEMETRY MANUAL

CONTENTS

2.0 UNPACKING

1. Remove all items from packing cases and check that all items supplied match the order.

2. Identify outstation and instation equipments by referring to Table 1 at the end of this manual.

3. Check that the equipment has not been damaged in transit and that there are no loose items within the enclosure.

   The **CONFIGURATION SCHEDULE** at the end of this manual identifies the circuit board make-up of each terminal, the power supply arrangements expected and circuit board jumper positions.

4. If a battery is supplied for the equipment consult the **CONFIGURATION SCHEDULE** to identify the battery with the correct capacity.

5. The cases are designed for wall fixing and incorporate a removable gland plate. Follow the instructions on the sheet affixed to the enclosure for fixing the wall mounting brackets and gland drilling.

3.0 INSTALLATION AND COMMISSIONING

AERIAL

1. Install aerial referring to **AERIALS** section of this manual.

POWER SUPPLY

2. Check power supply arrangements referring to **POWER SUPPLIES** in the **CONFIGURATION SCHEDULE** of the manual.
3. Ensure that correct voltage is selected where appropriate.
4. Connect the battery.
5. Switch on power supply. Check that the charger is charging by measuring the voltage across the battery terminals. A voltage of 13.8 should be indicated for a fully charged battery; the voltage will be lower for a discharged battery.
   If no battery is included check for 13.8V across the power supply output terminals.
6. Connect 12V supply lead to PL3 on the processor board.

INITIAL POWER UP

7. Ensure that all bits of switch SB are OFF and that SA is set to the correct station address, as shown in Configuration Schedule.
8. Connect radio aerial to case connector.
9. Confirm that the "watch dog" (WD) LED on the processor board is flashing when power is applied.
10. Referring to **COMMUNICATIONS** section of the manual confirm that LEDs, RTS and TX flash periodically as the station transmits. The exact behaviour varies according to the system specification, as detailed in the **CONFIGURATION SCHEDULE** section.

INPUTS

11. Refer to Table 1 for details input terminal connections.
12. Connect digital inputs to indicated terminal positions.
    NOTE - At sites where pumpstarters are installed , an earth wire(30/.25) is required. A connection should be made from the chassis earth stiud to the digital input 8 common (C) connection on the processor board. Where equipment is fitted with more than 8 digital inputs a similar earth lead connection should be made from any common terminal ‘C’ on each digital input board to the chassis earth.
13. If a display board is fitted, confirm correct status displayed for each input on LEDs.
14. Connect digital inputs to indicated terminal positions and leave analogues at a known value.
15. If display board is fitted use selector switches SA and SB to select each input display on the LCD. Position 0 on SA and 1 on SB displays analogue 1, Position 0,2 shows analogue 2. If more then 9 then SA=1 SB=0 displays analogue 10, SA=1 SB=1 displays analogue 11.
16. If pulse input facility is available select either voltfree or 24v pulse option on SW1 for pulse inputs on pulse board. Select appropriate pre-scale position for J1 and J2 on pulse board.
17. Connect pulse inputs to indicated terminal positions.
18. Monitor first 8 bits of pulse counts accumulator on LEDs 1-8 on display board by invoking diagnostic test 10. Monitoring the LEDs will confirm reception of pulse signals from plant. The LED on the pulse input board should indicate input pulses, even if no display board is fitted.

OUTPUTS

19. Proceed to the station giving outputs corresponding to the inputs that have been set up.
20. If station has yet to be switched on repeat checks 1-9.
21. Check that communications LEDs, CD and RX flash to indicate reception of a message. Identify the equipment Configuration, then from the **COMMUNICATIONS** section confirm that the station shows the correct communications characteristics.
22. Refer to Table 1 for details of output terminal connections.
23. Confirm communications alarm relay is energised confirming correct reception of message.
24. Confirm that digital output states correspond to the appropriate input states.
25. Confirm that each analogue output follows the corresponding input over its full range by monitoring the output current.
26. Confirm that pulse outputs correctly reproduce the pulse inputs.
27. Disconnect aerial and confirm that the communications alarm LED extinguishes after the appropriate time out period (see **CONFIGURATION SCHEDULE**) to indicate a communications failure.
28. Re-connect aerial and confirm that communications alarm relay comes back ON (LED ON).
29. Repeat **INPUT** (11-18) and **OUTPUT** (19-28) checks until all inputs and outputs have been checked and reconciled.

Please refer to the **DIAGNOSTICS** section if any abnormal behaviour is observed, or if analogue calibration checks need to be made.

4.0 AERIALS

YAGI

A Yagi aerial consists of a reflector, a folded dipole and one or more director elements. When installing the aerial the director elements should be in the vertical plane and oriented towards the other station.
The aerial should be installed as high as is practical on a 2" diameter pole.

END-FED DIPOLE

The aerial is omni-directional and should be mounted vertically.
The base of the aerial is designed to fit the inside diameter of a 2" scaffold pole.
The aerial should be installed as high as possible.

STUB

Used only for links over very short distances (typically a few hundred yards) and is omni-directional. The aerial screws on to the connector on the top of the equipment case.

LIGHTNING PROTECTION

Lightning protector CA90/T is a protection device designed to ensure that excessive electromagnetic interference induced into an aerial does not cause damage to a radio receiver. It is an in-line component mounted in series with the aerial feeder and incorporates an earthing stud which should be wired directly to an earth rod.

When using external aerials the downlead must be as short as possible. In circumstances where downlead length is too short only correct coaxial fittings should be used to extend the feeder length. The factory can give guidance on the types required.

5.0 POWER SUPPLIES

The circuit boards and radios of the telemetry equipment share a 12V D.C. supply. The negative pole is earthed at the radio and cannot be isolated.

The equipment chassis plates are provided with an M6 earth stud. A dedicated earth connection must be made between the stud and the site earth point to avoid any earth borne interference. This connection should use stranded cable and must have a resistance less than 0.1 ohms.

For sites incorporating motor starters an earth rod should be provided as a site earth point for telemetry equipment.

5.1 MAINS WITH BATTERY STANDBY

A 3 amp fused outlet should be provided for all mains powered options. For battery standby applications a 12V rechargeable sealed lead acid battery is provided to match the specified standby capacity.

LAC10 (CCL 2070)
Provides up to 400mA at 13.8V for charging the equipment and standby battery.
Mains voltages of 15V or 240V can be selected by means of an on-board switch.
A mains fuse, 500mA "F" fuse, is fitted.
A 500mA "T" fuse is fitted to protect output supply.

ERL 1 AMP CHARGER
15V (Verospeed 270-910493K) or 240V (Verospeed 89-3964F)
Provides up to 1A at 13.8v for charging the equipment and standby battery.
A 250mA "F" fuse is fitted as a mains fuse.
A 1A "F" fuse is fitted to protect output supply.
The power supply incorporates an LED which illuminates when the output fuse has blown.

RS 5 AMP CHARGER (RS 593-394)
Provides up to 5A at 13.8V for charging the equipment and standby battery.
Main voltages of 15V or 240V are configured by means of wiring straps on the charger.
No fuses are fitted. The mains outlet feeding the equipment should be protected with a 5A mains fuse.

5.2 EXTERNAL D.C. SUPPLIES

SPR10 - Solar Power Charge Regulator (CCL 3120)
Designed for use with 5W or 12W solar panels and provides regulated constant voltage for charging batteries.
A 1A "F"fuse is fitted to protect output supply.

DC-DC CONVERTER (RS 595-299)
Provides a 12V 1.2A equipment supply.
The input supply is fully isolated from earth and in the range 20-72V.

BATTERY ONLY
For outstations powered solely from a battery a 12V rechargeable sealed lead acid battery is provided.

5.3 POWER SUPPLY ALARMS

BATTERY LOW ALARM
For battery powered systems a battery low alarm is provided. A relay will be in the closed state for a battery voltage of over 11V. Should the supply fall below 11V then the relay will open, signalling a battery low state. The relay may combine both communications alarm and battery low or may be dedicated to battery low. As specified in the signal list.

MAINS FAILURE ALARM
On outstations which are mains powered with battery back-up and provided with a mains failure relay, an outstation mains fail alarm may be provided at the receiver. A normally closed relay will open to indicate a mains failure.

6.0 RADIOS AND MODEM

TECHNICAL SPECIFICATION

Frequency is a nominated channel in the 458.5-458.95MHz D.T.I. de-regulated band. (No licence required).
Maximum E.r.p. 500mW to DTI specification MPT1329.
Modem 1200 baud fsk. CCITT tones Mark 1300Hz. Space 2100Hz.
Check character 16 bit CRC, CCITT polynomial 8408H used.

DATA TRANSMISSION

The transmitted message is coded into a serial bit stream. A double byte check character is appended to each message to provide data security. A modem is used to code the message into tones for use by the radio. Each station has a unique station address so that the source and/or destination can be identified. These measures provide a high degree of data integrity for overall communications.
Four LED lamps on the processor board monitor the equipment communications status. A request to send lamp (RTS) comes on when the transmitter is powered and the TX lamp flashes during data transmission. A carrier detect lamp (CD) comes on in the presence of detected modem carrier and the RX lamp will flash during data reception.

6.1 COMMUNICATIONS MODES

6.1.1 SIMPLEX

A transmitter transmits a message to a receiver. Communication is one way only.

OUTSTATION

An outstation may work in one of three modes.

i) **CONTINUOUS**
Data will be transmitted regularly at intervals up to 5 seconds. The RTS and TX lamps on the processor board will flash as data is transmitterd. The pause in transmission allows other users to use the channel.

ii) **FIRMWARE TIMED**
Data will be transmitted at regular intervals determined by the program in the system EPROM. The RTS and TX lamps will flash when data is transmitted.

iii) **HARDWARE TIMED**
The system will power up at intervals determined by the setting of jumper J1 on the analogue input and timer board (4160 or 4250). Data may be transmitted at each power up or after a number of power ups, as determined by the program in the system EPROM. The RTS and TX lamps will flash when data is transmitted. The communications lamps may also flash momentarily as the system is powered up.

INSTATION

The instation may receive data from one or more simplex outstations. The equipment program will continually scan for transmissions from other outstations.
The CD and RX lamps will flash when an incoming transmission is detected. The transmission is checked for validity. Data will only be accepted if a message is valid with correct station address and cyclic code check.
If the CD and RX lamps come on unexpectedly this may be due to interference on the radio channel.

6.1.2 HALF DUPLEX

In half-duplex mode a station can transmit and receive data, but not at the same time.

LINK BETWEEN SINGLE STATIONS

Data is exchanged between two stations at intervals of up to 5 seconds. When the station transmits data the communications lamps RTS, TX, CD and RX will flash. The CD and RX lamps flash because the radio receives the transmitted message from its own transmitter, but this message is ignored. Upon reception of a message the CD and RX lamps will flash. Exchange of data will occur on a regular basis. If no reply is received there is a pause before another try is made. A pause between transmissions allows other users to use the channel.

LINK BETWEEN MASTER STATION AND OUTSTATIONS

MASTER STATION

The Master Station polls all outstations on a regular basis. When the station transmits data the communications lamps RTS, TX, CD and RX will flash. The CD and RX lamps show the stations own transmitted message, but this is ignored. On reception of a reply the CD and RX lamps will flash.

If no reply is received the Master Station will poll the next outstation, returning to re-transmit on the next polling cycle.

OUTSTATION

The Outstation will be polled periodically by the Master Station. On receiving a message the outstation program will check for its station address. On reception of a complete message with a valid station address the outstation will then read and transmit its own data for the Master Station.

The CD and RX lamps will flash periodically as polling messages are sent by the Master Station to all Outstations. When the outstation detects a valid message with its station address then all the communications lamps (RTS, TX, CD, RTS) will flash as a reply message is transmitted.

6.1.3 MIX OF SIMPLEX AND HALF-DUPLEX

In some cases systems may include station(s) with simplex communication and station(s) with half-duplex communications.

The equipment will pause in listening mode for a time, waiting for data from simplex stations, and then exchange data with half-duplex. The exact behaviour of the system depends on its particular characteristics, and it will show patterns of communication of both simplex and half-duplex.

The mode of communication of any particular system is included in the system specification.

6.2 COMMUNICATIONS ALARM

An alarm relay will normally be provided for each station. The alarm relay will be a normally closed contact (relay LED illuminated) and will open if no valid message is received within a specified period. This alarm relay may be combined with the battery low alarm or may be dedicated to communications only.

When the equipment is initially powered up the communications relay will be open and will only close on reception of a valid message.

See signal list for options(s) provided.

7.0 INPUT SPECIFICATION

DIGITAL INPUTS

Board 4000(Processor)
Provides 8 inputs for connection to volt free contacts. All inputs are returned to 0V common. Internal excitation voltage 12v and de-bounce circuitry incorporated.

Board 4010(Digital Input)
Provides either 8 or 16 inputs according to supplied fit. Inputs are for connection to volt free contacts. All inputs are returned to 0V common. Internal excitation voltage 12v and de-bounce circuitry incorporated. The full-fit board has four 8-way terminal blocks designated TB1, TB2, TB3 and TB4. TB1 is marked 1 C 2 C 3 C 4 C, where C provides the 0V return. The remaining terminal blocks are similarly marked for inputs 5 - 16.

Board 4240(Latched Digital Input Board)
Input arrangements as board 4000 and 4010.
Additionally provides a latched facility for up to 8 digital inputs to latch the change of digital states for systems operating in the timed mode.

ANALOGUE INPUTS

8 BIT ANALOGUES

Inputs are 8-bit (0.4%) resolution.
Input can be either

a) 4-20mA from externally powered transducer. Input burden is 68 ohms.
b) 1-5v input.

Boards provide input isolation from earth and power supplies.
Isolation rated at 500v D.C.

Boards 4160, 4250, 4030 (8-bit Analogue Input Daughter Boards)
Boards provide various options from 1 input to 4 inputs.
Input terminals(TB1) are marked with the input number and +/- polarity.

Board 4140 (8-bit External Analogue Input)
Board provides either 4 or 8 analogue inputs according to supplied option.
Each board has two terminal blocks designated TB1 and TB2. TB1 is marked +1- +2- +3- +4- to define polarity for each input. TB2 is similarly marked for inputs 5 - 8.

Board 4250
4-20mA from un-powered 2-wire transmitter operating over 10-14v range.

12 BIT ANALOGUES

Board 4475 (12-bit Analogue Input)
This board provides up to 8 analogue inputs all fully isolated via a flying capacitor technique. The inputs are sampled every 5 seconds and are converted to a 12-bit value (0.025% resolution). Each input is link selectable to cover the range 0-20mA, 0-5V or 0-2V.
Each board has two terminal blocks designated TB1 and TB2. TB1 is marked +1- +2- +3- +4- to define polarity for each input. TB2 is similarly marked for inputs 5 - 8.

Each input has an associated link comprising 3 pins with a jumper which can link 2 together. The two link positions are marked '**V**' and '**I**'. Fitting the link in the '**I**' position defines the input sensitivity as **0-20mA**(into 100Ω). Fitting the link in the '**V**' position sets the sensitivity as **0-5V** (125KΩ). Omitting the link sets the sensitivity to **0-2V** (> 1MΩ).

Switches 1 and 2 set the board address.

S1.2	S1.1	Board Address
0	0	0
0	1	1
1	0	2
1	1	3

N.B. 1= switch closed(ON), 0=switch open(OFF).

Switches 3,4 and 5 define the number of inputs which are unused.

S1.5	S1.4	S1.3	No. of inputs used
0	0	0	8
0	0	1	7
0	1	0	6
0	1	1	5
1	0	0	4
1	0	1	3
1	1	0	2
1	1	1	1

This allows a fully equipped board to be used in applications where only some of the inputs are required.

Self Test

The 12-bit analogue has its own self test facilites apart from those provided in software.
Switch 6 is normally open (logic '0'). Closing it sets the board to 'test mode' for calibration and checking linearity. In test mode the eight analogue inputs are sequentially compared with an internal reference (adjusted using VR1), at a rate of one every 125ms. In an input exceeds the reference the LED on the the board will light. At the end of the scan htere is a one second pause, during which the LED is off before the test is repeated. If a known signal level is applied to all inputs, and it exceeds the internal reference, the LED will light for one second then go off for one second. If it is below the reference the LED will be permenantly off. If it equals the reference the LED will flicker for one second and then be off for the next.

In test mode the internal reference is selected by switches S4/S5.

S1.5	S1.4	Reference(% full scale)
0	0	25%
0	1	50%
1	0	75%
1	1	100%

Full scale is defined as the digital value of 4000 decimal. The 12-bit resolution allows values up to 4095, so allows over-range values to be reported which may be used to signify fault conditions.

Analogue inputs may alternatively be calibrated by using the standard test software(see section **8.0**).

PULSE INPUT

Board 4170

Board selectable options are 24V isolated pulse or voltfree contact.
Pre-scaling of 1, 10, 100 provided on circuit board.
Maximum pulse rate 10 i.p.s.
M:S ratio, 1:4 minimum
Provision is made on the board to indicate the presence of a pulse by means of an LED.

7.1 OUTPUT SPECIFICATION

DIGITAL OUTPUTS

Boards 4015 (External Digital Output Board)
Provides up to 16 digital outputs. All outputs are fully isolated. Different addresses are selectable by an on-board link.Relay contact N/O rated at 240V A.C. maximum switched voltage, 0.5 Amp maximum switched current, 10 watts maximum switched power. A varistor across the contact is incorporated to protect contacts.
Outputs are arranged in groups of 4, with 8-way terminal blocks for connections marked TB1-TB4.
Terminals on TB1 are marked 1 1 2 2 3 3 4 4 whre each pair represents a volt-free contact.
LED indication, lamp ON shows closed contacts.

Board 4035 (5-way Digital Output Daughter Board)
Provides 5 digital outputs.
Specification similar to board 4015.

Board 4412/5(5-Amp Changeover Contact Digital Output Board)
Provides up to 16 digital outputs with connections available for normally open (NO) or normally closed(NC) contacts.
Relay changeover contact rated at 240v A.C. ,7 Amp maximum switched current. Mechanical life > 1,000,000 operations.

ANALOGUE OUTPUTS

8 BIT OUTPUTS

Boards 4050 (2-way Analogue Output) and 4130(4-way Analogue Output)
4-20mA electrically isolated from earth and power supplies. Isolation rated at 500v D.C. Digital to analogue conversion is from 8-bit binary providing a resolution of 0.4%.
Terminal block TB1 provides connection with terminals showing +/- polarity for output signal.

12 BIT OUTPUTS

Board 4470 (4-way Analogue Output)
Provides 4 analogue outputs, all fully isolated, giving 12-bit (0.025%) resolution. Each output is link selectable for the ranges 0-20mA or 0-5V. The board is configured using switches and links.
The board has an 8-way terminal block desginated TB1. Terminals are marked with +/- polarity for each output.
Each output has an associated link comprising 7 pins with 3 jumpers which can link 6 pins together in pairs. Each group of jumpers can be fitted in two positions, marked '**V**' and '**I**'. Fitting the links in the '**I**' position defines the output range as **0-20mA** (into **500Ω max**.). Fitting the links in the '**V**' position sets the range as **0-5V** (into **2.5KΩ min**.).

Switches 1,2 and 3 set the board address

S1.3	S1.2	S1.1	Board Address
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Switches 4 and 5 define the number of outputs unused.

S1.5	S1.4	No. of outputs used
0	0	4
0	1	3
1	0	2
1	1	1

This allows a fully equipped board to be used in applications where only some of the outputs are required.

Self Test

S6 is normally open (logic 0). Closing it sets the card into self test mode for calibration and checking linearity. In test mode an internally- generated referance is applied to all outputs simultaneously. Each output can be individually calibrated to give the required analogue output, by adjusting VR1, VR2, VR3 and VR4.

In test mode the internal reference is selected by S4 and S5

S1.5	S1.4	Reference(% full scale)
0	0	25%
0	1	50%
1	0	75%
1	1	100%

Note that full scale is defined as a digital value of 4000 decimal. The 12-bit resolution allows values up to 4095, so allows over-range values to be reported, which may be used to signify fault conditions.

Analogue outputs may also be tested using the resident diagnostic test software(see section **8.0**).

PULSE OUTPUT

Uses one of the digital outputs.

N/O voltfree reed relay contact rated as for boards digital output boards 4015 and 4035, with varistor contact protection and LED indication. Pulse period 83msec (12 i.p.s.).

DISPLAY BOARD

Board 4025

L.C.D.

Used to display the status of selected analogue inputs and/or outputs. The analogue to be displayed may be selected on selector switch SB (and SA if more than 10 analogues), position 1 selecting analogue 1, position 2 selecting analogue 2 (SA=1 SB=0 selects analogue 10, SA=1 SB=1 selects analogue 11). If the two selectors are left at zero the display will be blank. If the selectors are used to select an analogue which is not connected the display will show 000.0.

The value is displayed on a scale 0-100% with 0.4% increments for 8-bit values and 0.1% increments shown for 12-bit values.

On some systems the LCD may be used to display analogue output values.

L.E.D.s

Used to display the status of digital inputs as indicated on the legend plate.

Additionally local battery low status is displayed. On some systems additional LEDs may be used to indicate other status bits.

The display board is also used for various diagnostic test functions (see **DIAGNOSTICS** section).

8.0 DIAGNOSTICS

The program in the system EPROM provides a facility for carrying out diagnostic tests on the circuit boards. These tests are selected by means of a DIL switch on the processor board. For outstations operating in the timed mode it is necessary to change over two jumper positions on the processor board to enable the station to be continuously powered. For these stations, jumpers J1 and J2, located at the left hand side of the board, should be changed to positions "SBYDIS" and "PWRON" respectively for the duration of the testing. When selecting different tests the elements of SB should be set in a make-before-break sequence. A 3.5D digital multimeter is sufficient for carrying out most of the tests. Before investigating any fault check power supplies and fuses.
The components are closely packed on the circuit boards, so when making connections to test points use well insulated test probe leads to prevent any accidential bridging of connections.
Monitor test points on all printed circuit boards allow +12 and +5V D.C. power supplies to be checked with reference to an 0V test point on the board. The 5V supply is derived on the processor board. A 12V supply fuse of the appropriate rating is located on the processor board with its rating marked.
When carrying out diagnostic tests it is advisable to isolate any plant by removing the disconnect plugs from the circuit boards.

TESTS

Switch SB on the processor board is used to call various test and calibration routines to check circuit board functions. The number of the test corresponds to the element of switch SB used to select that test.
Before commencing note the station address setting on SA and then set all bits of SA to OFF.
When tests are completed reset SA to its station address setting.

1. Processor Test
   Exercises a simple routine that flashes the watch dog LED "WD" at about 1/4 second intervals.

2. Display Board Test - LEDs
   This test exercises each of the 4 rows of 8 LEDs on the display board. The test simply turns each lamp ON and OFF in turn. Switching bit 6 of switch SA will put all LEDs ON to allow fault finding.

3. Display Board Test - LCD
   This test exercises all characters of the 4-digit LCD.

4. Processor Board Ram Test
   This test checks the 8K of RAM (if IC8 is fitted) by writing 55h to all locations and calculating a CRC check. Any failure in reading back data is indicated by turning OFF LED L14 on the display board.

5. Modem Test

This is a loop back test on transmit and receive circuits to ensure that potentiometer RV1 on the processor board has been set up correctly. A continuous stream of characters AAh is transmitted with brief pauses and the received character is checked for validity and LED15 brought on to show agreement. Jumper J5 should be placed in the "T" position and the "CD" lamp will be kept on continuously. The "RX" and "TX" lamps flash simultaneously as the character is received. To check the setting of RV1 potentiometer, use an oscilloscope to monitor the RX and TX data signals on test points 9 and 10 respectively; trim potentiometer for equality in M:S ratio of the two waveforms. On completion of this test ensure that jumper J5 is replaced in the normal "N" position

6. Digital Inputs

This test reads the status of all digital inputs and displays in addressed groups of eight, the status on LEDs L9-L16 on the display board. DIL switch SA on the processor board is used to select which groups are displayed.

Binary Setting of SA	Digital Input Group Selected for Display
0	1-8 on processor board
1	Local inputs on display board from TB1 & TB2
2	Local inputs on display board from TB3 & TB4
3	1-8 inputs on 1st external board.
4	9-16 : 1st : :
5	1-8 : 2nd : :
6	9-16 : 2nd : :
7	1-8 : 3rd : :
8	9-16 : 3rd : :
9	1-8 : 4th : :
10	9-16 : 4th : :

Note: Bit 1 of DIL switch SA is LSB.

7. Digital Outputs

This test exercises each relay in turn on 5-way output daughter board (if fitted) and any 16-way external boards. DIL switch SA on the processor board is used to select which board to test, as follows:

Binary Setting of SA	Board Test
0	5-way daughter board & 1st external board.
1	: : 2nd external board
2	: : 3rd external board
3	: : 4th external board

Note: Bit 1 of DIL switch SA is LSB. Set bit 6 of SA ON to set all relays on a board.

8. Analogue Inputs

This test continuously encodes a selected channel and displays the digitised signal expressed as a 0-100% reading(0-4000 counts for 12-bit analogues) on the LCD on the display board. A single potentiometer for each channel on the A/D converter board is used to set the calibration. The potentiometer is identified on the board as RV1 for channel 1, RV2 for channel 2 etc.

SA and SB on the display are used to select the analogue channel for display. If less than 10 analogues are used then switch SA will be omitted.

Setting of SA and SB		Channel for display on LCD
SA	SB	
0	0	1
0	1	2
0	2	3
0	3	4
0	4	5
....		....
3	1	32

9. Analogue Outputs

For equipment fitted with analogue output boards, outputs of 4, 12 and 20mA(0,10,20mA for 12-bit analogues can be generated by setting bits 1,2 or 3 of SA on the processor board to check span and zero potentiometer settings.

Bit Setting on SA	Output Current/mA(Output 12-bit)
Bit 1 set only	4 (0)
Bit 2 set only	12 (10)
Bit 3 set only	20 (20)

Potentiometer RV1 is the zero whilst RV2 is the span adjustment.

Potentiometer RV3 on the board sets the output impedance of the circuit. To check the setting proceed as follows:

a) Connect a resistor of 330R to 470R in series with a digital multimeter. Measure the analogue output and connect a switch across the resistor to enable it to be shorted out.
b) Set SA to give 20mA output.
c) Open and close the switch across the resistor and record the change in output current.
d) If the output changes by more than 0.01mA make a small adjustment to RV3 and repeat c).
e) Recheck span and zero settings and trim if necessary.

Potentiometers for other analogue channels are consecutively identified.

10. Pulse Count Testing

a) **Output**
Testing electromagnetic cyclometers may be exercised with this test. The test routine simply outputs batches of 10 pulses (at a 12 i.p.s. rate) to the pulse count output relays. Short pulses are introduced into the sequence to allow observation of the displayed count.

b) **Input**
Testing the least significant byte of the pulse count accumulator at the Outstation. For the test it is necessary to set element 1 of switch SA in addition to element 10 of SB. The accumulator value for channel 1 is displayed on LEDs L9-L16 on the display board, and correct operation of the counter can be verified when pulses are present. In order to view the pulse accumulator for channel 2, set elements 1 and 2 of SA in addition to element 10 of SB.

CONFIGURATION SCHEDULE

9.0 OUTSTATION **Serial No.**

AERIAL	Dipole		Yagi		Stub	

POWER SUPPLY	Mains LAC10		Mains ERL 1 Amp		RS 5 Amp	
	Solar		DC/DC converter		RS 1 Amp	
	Nominal supply voltage		V	a.c./d.c.		

BATTERY FIT	Ahr

RADIO	Simplex		Duplex	
	Frequency	458. MHz		
	Power	mW		

Communications alarm time out period	minutes

PROCESSOR BOARD 4000

Issue		EPROM		EPROM Iss	

RAM fitted in IC8	

STATION ADDRESS SETTING ON DIL SWITCH SA						
BIT	1	2	3	4	5	6
ON						
OFF						

Jumper positions				
J1	SBYDIS		SBYEN	
J2	PWRON		PWROFF	
J3	600		1200	
J4	RAM		EPROM	
J5	T		N	
J6	ON		OFF	
J7	P50		IRQ	
J8	R		IRQ	

OUTSTATION

EXTERNAL BOARDS

Board No.	Type	Drg.	Issue	I/O Capacity						Links	
				Input			Output				
				D	A	P	D	A	P	J1	J2
1	**PROCESSOR**			8							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

CONFIGURATION SCHEDULE

9.1 INSTATION **Serial No**_____

AERIAL	Dipole		Yagi		Stub	

POWER SUPPLY	Mains LAC10		Mains ERL 1 Amp		RS 5 Amp	
	Solar		DC/DC converter		RS 1 Amp	
	Nominal supply voltage		V	a.c./d.c.		

BATTERY FIT	Ahr

RADIO	Simplex		Duplex	
	Frequency	458. MHz		
	Power	mW		

Communications alarm time out period	minutes

PROCESSOR BOARD 4000

Issue		EPROM		EPROM Iss	

RAM fitted in IC8	

STATION ADDRESS SETTING ON DIL SWITCH SA						
BIT	1	2	3	4	5	6
ON						
OFF						

Jumper positions				
J1	SBYDIS		SBYEN	
J2	PWRON		PWROFF	
J3	600		1200	
J4	RAM		EPROM	
J5	T		N	
J6	ON		OFF	
J7	P50		IRQ	
J8	R		IRQ	

EXTERNAL BOARDS

Board No.	Type	Drg.	Issue	I/O Capacity						Links	
				Input			Output				
				D	A	P	D	A	P	J1	J2
1	**PROCESSOR**	4000		8							
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											