TELEMETRY LINK

30R

Version 3.2 - 07.10.94

CHURCHILL CONTROLS LTD
UNIT 2, STATION INDUSTRIAL ESTATE
OXFORD ROAD
WOKINGHAM
BERKS.
RG41 2YQ

TEL: 0118 9892200
FAX: 0118 9892007

30R MANUAL

APPENDIX

CONTENTS

APPENDIX - DIAGRAMS, TABLES, ETC.

SECTION 1

Introduction

1.1 CHURCHILL CONTROLS 30R TELEMETRY LINK

The 30R is a 1-way radio telemetry link for transmitting the status of up to four digital inputs, two analogue inputs and an optional pulse count input. The output at the receiver mirrors the input at the transmitter.

Digital inputs are read as volt free contacts at the transmitter and this data is reproduced at the receiver via relay contact. A variety of different analogue input options are available. Analogue outputs at the receiver are either 4-20mA or 0-10mA.

The transmitter functions in a timed mode. The equipment is powered up at pre-set intervals to read input signals and transmit data in a short message. Transmitted messages incorporate a sophisticated check character to preserve integrity of data in the presence of radio interference. Data will be updated at the receiver on validation of a received message. The transmitter may be operated in a test mode where data is transmitted continuously thus facilitating the commissioning of the equipment.

Some applications require the use of more than one transmitter. The receiver can be set to enable reception of data from two 30R transmitters, each being able to transmit one analogue and two digital signals. For more demanding requirements up to sixteen 30R transmitters may be used, each handling up to four digitals and two analogues, with a single 20R receiver to output all data. In some cases systems may combine both 30R and 20R transmitters sending data to a 20R receiver. For systems which incorporate one or more 20R terminals this manual should be used in conjunction with the 20R manual.

SECTION 2

Operation and Use

2.1 RADIO COMMUNICATION

The 30R link operates within the low power UHF telemetry band located at 458.500 to 458.950MHz in the U.K. The band is divided into 32 channels and no licence is required. Howevr, frequencies 458.8250mhz, 458.8375mhz and 458.9000mhz should not be used as these are for mobile alarms only.

Links which are within range of each other may be operated in the same frequency but the user should ensure that each link is given a separate address (see Sections 3.2.1 and 3.3.1 for station address selection).

Before installation check that the carrier frequency of the transmitter and receiver are the same. The frequencies are marked on the labels on the radio modules inside the cases.

2.1.1 RADIO MODULES

The equipment is fitted with radio modules manufactured by Wood & Douglas.

TRANSMITTER

The equipment is fitted with a Wood & Douglas 25mW, 50mW or 500mW transmitter. See Section 5 for radio type numbers fitted, radio power and frequency.

RECEIVER

The receiver is fitted with a Wood & Douglas TR450 unit.

2.1.2 AERIALS

2.1.2.1 YAGI

Advisable for use on links of several kilometres.

A Yagi aerial consists of a reflector, a folded dipole and one or more director elements. When installing the aerial the director elements must be in the vertical plane and orientated towards the other station. A yagi aerial should **NOT** be used with a 500mW transmitter as this would contravene the DTI Low Power radio regulations.

The aerial should be installed as high as is practical on a 2" diameter pole.

For installation diagram see Fig. 2 in Appendix.

2.1.2.2 END-FED DIPOLE

Suitable for use on links of less than one kilometre to a few kilometres.

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. For installation diagram see Fig 2 in Appendix.

2.1.2.3 STUB

Used only for links over very short distances (typically a few hundred metres) and is omni-directional. The aerial screws on to the connector on the top of the equipment case. A stub aerial should not be used with a 500mW transmitter as local interference effects with analogue signal cabling may occur owing to the high local field strength.

2.1.2.4 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.

2.1.2.5 DOWNLEAD

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. Churchill Controls Ltd can give guidance on the types required.

2.2 TX30R TRANSMITTER

The transmitter is housed in a diecast aluminium enclosure measuring 260 x 160 x 90mm which fulfils the IP65 standard. The lid of the enclosure can be removed to provide access to the transmitter. The unit contains all of the sensing circuitry, together with a UHF radio transmitter and internal battery as required. User switches provide rapid and simple station address selection, as well as enabling selection of various transmitter options. A circuit board jumper allows selection of test mode.

2.2.1 DIGITAL INPUTS

Up to four closed/open signal contacts from plant can be connected to TB2. If long cable runs to plant are involved it is preferable to use a twisted pair of wires for each contact. One wire of each input is common on the circuit board and is connected to the earth.
Digital input 1 may have alternative use as a pulse input from volt free contact. For digital input option ensure that jumpers J1 and J2 on the board are set to "D".

All the inputs incorporate a 10K ohms pullup resistor to internal 12V supply and are optically isolated from the CMOS circuitry. Inputs are suitable for use with volt free contacts or from an open drain or open collector NPN transistor.

For installations using one receiver with two transmitters only the first two digital inputs on each transmitter may be used.

2.2.2 ANALOGUE INPUTS

Two analogue channels are available, identified as A and B on the circuit board. Each channel can accept one of five options selected on the mother board by means of a plug-in daughter board. Wiring arrangements for each option are shown on the enclosure lid and appropriate wired connections are made to TB1.

Before any connections are made check that the correct type of daughter board is fitted. The board type can be identified by referring to the "option fit" box printed on the board. A black spot indicates its calibrated option.
Fig 1a at the rear of this manual details connections for the following transducer interfaces:

1. 4-wire pressure transducer.
2. 2-wire 4-20mA transducer.
3. Externally powered 0-10mA or 4-20mA input.
4. 1-5V input.
5. Potentiometer input.

For externally powered current inputs the negative connection is earthed as it is connected to equipment 0V. If this presents a site problem owing to other earth points in the current loop, then it will be necessary to insert a current isolator before making connection to the transmitter analogue input.

None of the three wires from the potentiometer should be connected to earth.
If long cable runs to plant are involved adjacent to mains cables, all analogue connections must be made with twisted pair cable and screened.
Pressure transducer earth leads must be connected to an M6 eyelet and inserted under the earth screw at the bottom left hand side of the enclosure.

For installations using one receiver with two transmitters only analogue input channel A may be used on each transmitter.

2.2.3 PULSE COUNT INPUT

Pulse train inputs may be handled on single transmitter systems or where several 30R transmitters communicate with a 20R receiver.

The input has a 10K ohms pull-up resistor to the 12V supply and is suitable for use with volt free contacts. Input should be at a maximum of 1 p.p.s.
Pulse input mode is selected by setting jumpers J1 and J2 on the processor to position "P".
The digital output (output 1) at the receiver follows the pulse count input at the transmitter.

2.2.4 TIMING OPTIONS

All the switch options detailed here are shown on the label inside the transmitter lid.

2.2.4.1 TRANSMISSION TIMING

The interval between transmissions is selectable on the DIL switch on the circuit board. Elements 9 & 0 are used to select transmission intervals as follows:

Bit 9	Bit 0	Interval between transmissions
OFF	OFF	30 seconds
ON	OFF	2 minutes
OFF	ON	4 minutes
ON	ON	16 minutes

2.2.4.2 DATA CHANGES OPTION

Invoked by setting element 6 ON.
Enables transmission of a message within 30 seconds of either a 2% change in an analogue input value (over the full range) or a change of state of a digital input.

2.2.4.3 ANALOGUE SETTLING DELAY

The interval between switching on 5V and 18V excitation terminals and transmitting data can be set to allow a particular analogue settling period. Using elements 7 and 8 of the DIL switch on the circuit board. Delays are selected as follows:

Bit 7	Bit 8	Settling Delay
OFF	OFF	0.25 seconds
OFF	ON	1 second
ON	OFF	4 seconds
ON	ON	16 seconds

2.2.5 TEST MODE

The transmitter can be operated in continuous mode to allow checking of inputs. Messages are sent approximately every half second.

To select test mode move jumper J3 to the "T" position.

2.2.5.1 RADIO SIGNAL TEST

An additional facility is provided in test mode to allow a radio signal test to be carried out. The data character "AA" (binary 10101010) will be sent continuously by the transmitter allowing monitoring of the transmitted signal. This character will produce a square wave on TP10 of the receiver.

2.3 RX30R RECEIVER

The receiver is housed in a diecast aluminium housing similar to that of the transmitter measuring 260 x 160 x 90mm. A removable lid allows easy access to the receiver unit. The receiver contains all the circuitry required, plus a UHF radio receiver and internal lead acid battery. A switch located on the circuit board allows setting of a station address along with various system options.

2.3.1 DIGITAL OUTPUTS

Four digital outputs are available on TB2 and are identified 1-4. Each output is a volt free contact rated at mains voltage and is provided with a varistor to absorb spark energy. The output state is indicated on an LED above each relay. The LED is illuminated to show a closed contact.

2.3.2 ANALOGUE OUTPUTS

Channel A and B analogue outputs are available on TB1. Jumpers J1 and J2 select 0-10mA or 4-20mA outputs. The normal factory calibration is 4-20mA. Outputs are common negative and connected to the case earth. Loop resistance of 1000 ohms can be tolerated for 4-20mA outputs and 200 ohms for 0-10mA output.
The calibration section (3.4) shows how to change output calibration.

2.3.3 PULSE OUTPUTS

The 30R allows output of a pulse train derived from the transmitter. The pulse output uses digital output 1. Output is at a rate of 5 pps. This rate is quicker than the input rate allowing for quick output after timed transmissions.

2.3.4 COMMUNICATIONS ALARM

The receiver is provided with a means of indicating a loss of communications. The state of communication is indicated on digital output 7 (both 7 and 8 are used for dual transmitter systems) and the normal state of this output is a closed contact (LED on). If no valid message is received within a set time then the contact will open (LED off) to show a communications failure. The output will reset once a valid message is received. The period of alarm time-out is three times the period between transmissions as set up at the transmitter (section 2.2.4.1).

2.3.5 BATTERY LOW ALARM

A battery low alarm signal is sent from the transmitter and is indicated on digital output 5. The normal state of this output is a closed contact (LED on). If a battery low condition is detected at the transmitter the output will open (LED off). The output resets once the alarm condition is cleared.

2.3.6 MAINS FAILURE ALARM

A mains failure alarm signal is sent from the transmitter and is indicated on digital output 6. The normal state of this output is a closed contact (LED on). If a mains failure is detected at the transmitter the output will open (LED off). The output resets once the alarm condition has been cleared, a mains O.K. signal being sent from the transmitter.

2.3.7 DATA STATUS ON COMMUNICATIONS ALARM

A number of elements of the receiver board DIL switch are used to select the status of digital and analogues outputs on communications failure. Switch settings are detailed in section 3.3.1.

2.3.8 TWO TRANSMITTER SYSTEMS

For systems with two transmitters DIL switch element 5 should be set ON.

2.3.8.1 DIGITAL OUTPUTS

Digital outputs 1 and 2 are used for data from the first transmitter, outputs 3 and 4 for data from the second transmitter. There is no pulse count mode available with two transmitters.

2.3.8.2 ANALOGUE OUTPUTS

Analogue output channel A is used for the analogue signal from the first transmitter, channel B for the analogue from the second transmitter.

2.3.8.3 ALARMS

Each transmitter has a communications alarm output; number 7 for the first, number 8 for the second. Battery low alarm and mains failure alarm use the same outputs as per single transmitter but bits are shared and operate in an either/or manner.

2.3.9 TEST MODE

Element 0 of the DIL switch is set ON to select test mode which tests the receiver outputs.
The digital outputs are tested by setting each output in turn for approximately half a second. The test "steps through" the outputs in turn.
The analogue outputs are tested by sending a selected value to both outputs. Values are selected on elements 1 and 2 of the DIL switch.
See section 3.3.1 for details of switch settings.

2.4 POWER SUPPLY

The various power supply options for the 30R transmitter are as follows:

1) Mains 240/110V A.C. supply. Voltage is selected by means of a switch (SW1) on the printed circuit board.

2) Mains supply as 1) with 1.8 A.h. rechargeable battery standby facility.

3) External 12V battery.

4) External 15-30V D.C. supply.

5) External 15-30 D.C. supply with 1.8 A.h. rechargeable battery standby facility.

6) Solar charger panel connected to the 15-30V external supply terminals with the 1.8 A.h. internal battery used for normal operation.

NB For mains powered equipment the consumer outlet supply must be rated at 2 amps, as there is no mains fuse incorporated within the equipment.

The mains transformer is rated at 6VA and mains circuitry incorporates a mains interference filter. For transmitters using a mains power supply Jumper J4 should be in the "MAINS" position. For all other options the jumper should be in the "EXDC" position.

A 12v 1.8 A.h. sealed lead acid battery is normally incorporated in the equipment, located under the circuit board, providing a power standby facility. The battery drain at the transmitter site will depend upon the transmission interval, analogue settling time and the power requirements for any external transducers. For transmitters intended for operation from a battery only, an external battery and battery box may be supplied. Table 2 (see Appendix) gives battery standby capacities for the internal 1.8 A.h. battery. Tables 3a, 3b and 3c give capacities for 3.0, 5.7 and 9.5 A.h. external batteries. All the Tables relate to equipment fitted with the standard 25mW radio transmitter.

A battery low signal is sent from the transmitter. This condition is indicated when battery output falls to about 10V and is reset once output reaches 12V.

The transmitter lid shows details of the connections for the appropriate power supply.

2.4.1 OPERATION FROM SOLAR CELLS

The transmitter is designed for operation from a solar cell. A suitable charge regulator for the internal battery is included on the circuit board. The solar cell should have an operating point voltage of at least 15V, and a maximum open circuit voltage not exceeding 30V. The panel connections are made to TB4 15-30V D.C. input and the internal 1.8 A.h. battery is connected to PL5. A 5w solar panel is adequate for most applications. Table 1 (see Appendix) summarises transmission intervals and transducer settling times which are used to provide a totally maintenance free installation using the internal battery powering two external transducers, both at 20mA.

A 5w panel power rating will support battery capacities of 5.7 A.h. or less for any part of the U.K. A 10w panel should be used when batteries exceeding 5.7 A.h. are used.
Mounting arrangements for 5 and 10 watt solar panels are shown in Appendix Fig 3.

2.5 CONNECTIONS

Three 20mm cable glands are supplied with each enclosure and each has a red insert to seal the cable hole. This provides a blanking facility for any gland hole not required. The glands are suitable for circular cables of 7-10.5mm diameter.

If it is necessary to drill the enclosure for alternative glands it is vital that the circuit board assembly is first **REMOVED** from the enclosure by loosening the four retaining screws.

All external cables are terminated on to the board using the port connectors with screw terminals. The terminals are suitable for cable conductors 0.5-1.5mm. Connection arrangements for supply and signal inputs are printed on the circuit board and on the enclosure lid.

2.5.1 SUPPLY CONNECTIONS

2.5.1.1 MAINS

For mains powered installations terminate the mains cable at the 3-way socket TB3 and select the appropriate supply voltage on the mains voltage selector switch. This is located adjacent to the mains terminal block.
The mains supply should be fused at 2 amps.
For the transmitter ensure jumper J4 is in the "MAINS" position.

2.5.1.2 EXTERNAL D.C.

For the transmitter ensure jumper J4 is in the "EXDC" position.
Connections for D.C. powering 15-30V are made to TB4.
The supply negative is internally connected to the case earth and must be fused at 250mA. If a solar panel is used for charging the internal battery it must be connected to the 15-30V terminals. Transmitters for operation from battery only without any means of charging will be supplied with an external battery box. The external battery is connected to the terminals identified 12V on TB4. Tables 2, 3a, 3b and 3c at the rear of the manual show battery life for specific applications.

2.5.1.3 FUSE

The equipment fuse is a 20mm 250mA "F" type located in a bayonet holder. Thus the internal and external battery connections are protected from any accidental polarity reversal.

SECTION 3

Installation and Commissioning

3.1 EARTHING

The transmitter and receiver are fitted with interference suppression components for both mains and signal circuits. For effective protection it is vital that a good earth is provided.

A mains safety earth connection is provided on the mains terminal block. This connection is designed for personal safety.

The mains earth is often inadequate to protect sensitive electronic circuits from the high voltage transients that are often generated in signal cabling when large motor contactors operate. Where installations employ such heavy plant it is advisable to make an additional low impedance earth connection to the enclosure.

3.1.1 EARTH CONNECTION

Use an M6 eyelet with a stranded 30/0.25 earth cable. The eyelet should be inserted under the copper M6 board fixing screw indicated by the earth sign on the circuit board (adjacent to mains terminal). The earth cable should be run as directly as possible to an earth rod or busbar having direct connection to site earth.
Where aerial lightning protection is fitted a dedicated earth cable should be run from the earth fixing screw direct to site earth.

3.2 TX30R TRANSMITTER COMMISSIONING

1) Connect the power supply and any standby battery.

2) Ensure Jumper J4 is in the "MAINS" position for mains powered option and in the "EXDC" position for other supply options.

3) Invoke test mode by placing jumper J3 into "T" position.

4) The transmitter should now be powered up continuously and the "TX" LED illuminated. If the LED fails to come on check the 250mA board fuse and the presence of external voltage across the appropriate supply terminals.

5) Connect the analogue and digital wired sockets into their respective plugs on the circuit board.

6) Connect the radio aerial (see section 2.1.2 for aerial types).

7) Use a digital multimeter set to measure voltage. Connect the -ve lead to 0V or case earth and the +ve lead to TP8 labelled "A" at the top of the board.

3.2

8) Exercise channel A analogue over its measuring range and confirm a multimeter reading of 100mV at zero point and 5.10V at full scale.

   If it is necessary to trim zero or span set appropriate channel input at its zero value first trim "ZERO" pot on analogue daughter board for 100mV ± 10mV then set 100% input and trim "SPAN" potentiometer for 5.10mV ± 10mV.
   Repeat trimming process at 0% and 100% until consistent measurements are obtained. If it is not possible to generate a 100% reading from the transducer a 50% value can be used by adjusting the "SPAN" pot for a voltage reading of 2.60V, ± 10mV.

9) Connect multimeter +ve lead to TP9 "B" and repeat 7) for channel B analogue.

10) If Pulse count input is required on digital input 1 check that jumpers J1 and J2 are set to "P" and bit 5 of the DIL switch is set "ON". Otherwise check that J1 and J2 are set to "D" and bit 5 of DIL switch is set "OFF".

11) If commissioning a transmitter of a two outstation system note that only channel A analogue and digital inputs 1 and 2 can be used. Pulse count mode is not available in a two transmitter system.

12) Set DIL switches on circuit board appropriate to application (see Section 3.2.1).
All DIL switch functions are listed on a label attached to the inside of the enclosure lid.

3.2.1 SWITCH CODES - TRANSMITTER

DIL SWITCH
ELEMENT

1-4 STATION ADDRESS
On links with a single transmitter the address should be identical to that of the receiver.
On two transmitter links the first transmitter has an address identical to that of the receiver whilst the second would be set to a value of receiver address + 1 (element 1 is Least Significant Bit).
In case of multiple transmitter to 20R receiver make note of the address specified in the Configuration Schedule (Section 5.0).

5 PULSE COUNT MODE SELECT
ON for pulse count mode, OFF if no pulse count.

6 DATA CHANGED TRANSMISSION
ON for transmission within 30 seconds if analogue has changed by 2% (over 100% range) or digital status has changed.
OFF for timed transmission.

7-8 ANALOGUE SETTLING DELAY
Time between equipment power-up and reading analogue signals.

Element 7	Element 8	Delay
OFF	OFF	0.25 seconds
OFF	ON	1 second
ON	OFF	4 seconds
ON	ON	16 seconds

Power remains switched to 5V and 18V excitation terminals on TB1 during these delay periods.

3.2.1

DIL SWITCH
ELEMENTS

9-0 TRANSMISSION INTERVALS

Element	**Element**	
9	**0**	Transmission interval
OFF	OFF	30 seconds
ON	OFF	2 minutes
OFF	ON	4 minutes
ON	ON	16 minutes

3.3 RX30R RECEIVER COMMISSIONNING

1) Connect the power supply and any standby battery.

2) Invoke test mode by switching element 0 of DIL switch on the circuit board.

3) The receiver will now be powered and the "watch dog" (WD) LED located in the top RHS of the enclosure should be flashing regularly.

4) If the "WD" lamp fails to come on, check supply voltages and connections and the 250mA circuit board fuse.

5) The test sequence closes each output relay in turn and flashes its associated LED.

6) The calibration of analogue outputs may be checked by using a current meter connected to the channel outputs on TB1.

Outputs of 0%, 50% and 100% may be checked by setting elements 1-2 of the DIL switch in addition to element 0 as follows:-

0% output element 0 only ON.
50% output element 1 or 2 ON (not both) and element 0 ON.
100% output elements 1, 2 and 0 ON.
Span and zero potentiometers are available on each output for making small adjustments. Circuit jumpers J1 and J2 select between 4-20mA and 0-10mA output. For calibration details see Section 3.4.

7) Set jumper J3 (located by DIL switch) to "W&D".

8) Connect radio aerial to case connector.

9) Check that 30R transmitter is in test mode. [Section 3.2 (2)].

10) Check the squelch "SQ" LED located in top LHS of enclosure is illuminated indicating the presence of an RF signal. If the LED fails to come on there is insufficient signal strength. The radio path may be obstructed or aerial alignment needs to be checked (see Section 2.1.2).

11) Set up DIL switch elements to configure receiver to decode signal from 30R transmitter.

12) The receiver will now output analogues and digitals from the transmitter. Check that outputs marked "Batt", mains fail "M/F" and communications alarm 1 "Comms 1" are all ON indicating a charged battery, mains supply live and healthy communications respectively. If the mains supply is not wired the "M/F" lamp will remain off to indicate an alarm situation.

13). Exercise transmitter analogue and digital inputs to ensure correct receiver response.

14) Set transmitter to normal mode by transmitter jumper J3 to "N" position.

3.3

15) If commissioning a single transmitter system proceed to 20. For a two transmitter system invoke test mode on the second transmitter.

16) Set bit 5 on receiver DIL switch to enable the reception from two transmitters.

17) Ensure the receiver squelch lamp "SQ" is on.

18) Check that "Comms 2" alarm relay is energised showing good communications with the second station.

19) Exercise analogue "A" and digitals 1 and 2 on the second transmitter to ensure correctly received signals.

20) Set transmitter to Normal mode.

21) Set analogue and digital alarm options on DIL switch (see Section 3.3.1).

3.3.1 SWITCH CODES - RECEIVER

DIL SWITCH
ELEMENT

1-4 STATION ADDRESS
On links with a single transmitter the address should be identical to that of the transmitter.
On two transmitter links the receiver address should be identical to that of the first transmitter.

5 TWO TRANSMITTER SELECT
ON if two transmitters are in use.

6-7 ALARM OPTIONS DIGITALS

Element 6	Element 7	Digital State
OFF	OFF	Held at latest received state
OFF	ON	All open contact (0)
ON	OFF	All closed contact (1)
ON	ON	All closed contact (1)

8-9 ALARM OPTIONS ANALOGUE

Element 8	Element 9	Analogue state
OFF	OFF	Held at latest received state
OFF	ON	All 0%
ON	OFF	All 100%
ON	ON	All 100%

DIL SWITCH
ELEMENT

0 TEST MODE

Selects digital and analogue output tests.
Analogue output also uses elements 1 and 2.

Element 1	Element 2	Output
OFF	OFF	0%
ON	OFF	50%
OFF	ON	50%
ON	ON	100%

3.4 CALIBRATION

3.4.1 TRANSMITTER ANALOGUE INPUTS

The transmitter is designed to accept any one of the following input options on channel A or B.

1. 4-wire pressure transducer.

2. 4-20mA input.

3. 0-10mA input.

4. 1-5V input.

5. Potentiometer input.

A plug-in daughter board incorporates signal conditioning circuitry to allow the different options to be interfaced correctly to the transmitter. The board is identified by a black spot in the "OPTION FIT" box.
All options provide a 5V analogue voltage span with a live zero of 0.10V. Independent Span and Zero potentiometers are provided on the daughter board for making small adjustments to measurement range. To check that a transmitter input has been set up correctly proceed as follows:

1) Connect digital voltmeter between TP4 and 0V on TP1.

2) Check that a reading of 5.10V is shown. If not, trim RV2 to achieve within $\pm$ 0.02V.

3) Place jumper J3 in test mode "T" to continuously power up the transmitter circuitry.

4) Connect +ve lead of digital voltmeter to TP8 "A" to monitor output voltage of channel A daughter board.

5) Position channel A transducer at 0% of its span and trim "Zero" potentiometer on daughter board for a reading of 100mV $\pm$ 10mV.

6) Position channel A transducer at 100% of its span and trim "Span" potentiometer on daughter board for a reading of 5.00V $\pm$ 10mV.

7) Repeat steps 5 and 6 until no further improvement in readings can be achieved.

8) If a daughter board is fitted for channel B repeat steps 4-7 with digital voltmeter positive lead connected to TP9 "B".

9) Revert transmitter operation to normal mode by placing J3 in position "N".

10) Confirm that correct analogue values are transmitted by monitoring channel A and channel B current outputs at the receiver.

3.4.2 RECEIVER ANALOGUE OUTPUTS

Provision is made on the board to generate a 0-10mA or 4-20mA analogue output signal. Circuit jumpers J1 and J2 select the required option for channel A or B respectively. Potentiometers are provided for independent adjustment of Span and Zero on channels A and B. A calibration test routine is provided in the receiver programme.
To check that Zero and Span have been set correctly proceed as follows:

1) With the receiver powered up set element 0 ON on the receiver DIL switch to provide a 0% output on channels A and B.

2) Connect a digital current meter to channel A output connections pins on TB1.

3) Trim "Zero" potentiometer RV2 for 0mA or 4mA output as required.

4) Set elements 2 and 0 only of DIL switch SW2 to provide a 50% output on channel A and B.

5) Trim "Span" potentiometer RV3 for 5mA or 12mA output as required.

6) Set elements 1,2 and 0 only of DIL switch Sw2 to provide a 100% output on channels A and B.

7) Check that a 10mA or 20mA output current is obtained.

8) Repeat steps 2-7 for channel B. The Zero potentiometer for channel B is identified as RV4 and the Span potentiometer as RV5.

9) When the calibration has been checked switch out the test functions bits 1, 2 and 0 on DIL switch SW2.

SECTION 4
SPECIFICATION

4.1 TRANSMITTER

Radio frequency: Low power industrial telemetry band 458.5-458.95MHz with 12.5KHz channel spacing.
TX power: 25mW standard, 500mW available as an option.

Operation
Transmission: 1200 baud FSK, message time approximately 100msecs.

Timed: Every 0.5, 2, 4, or 16 minutes - operator selectable. Also transmission on change of digital input state or change of analogue by 2%.

Security: 16-bit CRC characters appended to message.

Identification: 16 separate addresses, user selectable for outstation identification.

Analogue inputs
Number: Maximum of 2

Signal spans: D.C. voltage: minimum 0-11mV, max. 1-5V
D.C. current 0-10mA or 4-20mA (input resistance 10 ohms).
Potentiometer and straingauge bridges of > 500 ohms energised from a 5V supply in the transmitter, negative earth.

Earthing: Voltage inputs - negative pole earthed.
Current inputs - negative pole earthed through burden resistor.

Span selection: Plug-in daughter boards - each input separately selected.

Resolution: ± 0.4% (8 binary bits).

TX settling: Choice of 4 time delays, user selectable, for transducer settling. Range 0.25 to 16 seconds.

Digital inputs
Number: Maximum of 4 from voltfree contacts, TTL level signals or transistor open collector inputs.

Energising
Voltage: Internal 12V through 10K ohms.

Earthing: Common terminal earthed, "live" terminal opto-isolated.

Pulse count: One digital input can be used as a pulse count at a maximum rate of 1 p.p.s.

Power supplies: All power supplies are incorporated as standard as follows:

1. Rechargeable sealed lead/acid battery for battery only operation or as standby for other supplies.
2. 110/240V A.C. mains, consumption 6.5VA.
3. Battery charge regulator for use with solar panel.
4. External 15-30V D.C. -ve earth charging internal battery, 250mA max.
5. 10.8-13.8V D.C. external supply, 120mA max.

Alarms
Internal battery voltage low
Mains supply failure
Both alarms are transmitted to the receiver.

Power for external transducers and transmitters:

1. 16-20V unregulated from internal battery -ve earth. Maximum load 50mA.
2. 5V D.C. regulated. -ve earth, maximum load 20mA.

Both supplies are switched with the supply to the transmitter unit.

4.2 RECEIVER

Analogue Outputs

Number:	2
Span:	0-10 or 4-20mA operator adjustable.
O/P impedance:	> 0.25M ohms.
Max load resis.:	2000 ohms for 0-10mA 1000 ohms for 4-20mA
Earthing:	-ve pole earthed

Digital Outputs

Number:	4 data and 4 alarms
Rating:	Voltfree reed relay contact rated at 240V A.C. max. switched voltage, 0.5 amps max. switched current, 10 watts max. switched power, protected with 250V varistor.
Alarm outputs:	Transmitter battery voltage low. Transmitter mains supply failure. Communication failure (analogue and digital action on communication alarm; user selectable). Second communication failure for second out-station.
2nd Out-station:	Receiver can receive one analogue plus two digital signals from each of two outstations.

Power Supplies

110/240V A.C. mains (6.5VA) with battery standby for 12 hours.
External 14-30V D.C. -ve earth charging internal battery,
250mA maximum.
External 10.8-13.8V D.C. -ve earth, 140mA max.

4.3 GENERAL

Enclosures:	Diecast aluminium enclosures with cable gland ports, giving protection to IP65.
Finish:	Baked grey enamel.
Dimensions:	260 x 160 x 90mm
Aerial connector:	TNC
Ambient temp. range:	-20 to 50 deg C (operating).
Weight:	3.5Kg each unit.
EMC:	Designed to be compliant with emission standard EM50081-2 and immunity standard EN50082-2.

CONFIGURATION SCHEDULE

Transmitter

S/N..... Site.....
RADIO TRANSMITTER Type No..... Power.....mW
Frequency.....MHz

Address code on DIL switch ON OFF

Bit 1
Bit 2
Bit 3
Bit 4

Transmitter

S/N ..... Site .....
RADIO TRANSMITTER Type No..... Power.....mW
Frequency.....MHz

Address code on DIL switch ON OFF

Bit 1
Bit 2
Bit 3
Bit 4

Receiver

S/N ..... Site .....
RADIO RECEIVER Type No.....
Frequency.....MHz

Address code on DIL switch ON OFF

Bit 1
Bit 2
Bit 3
Bit 4

Battery capacity required to give a maintenance free operation

	Transmission Interval in Minutes			
Transducer Settling	0.5	2	4	16
0.2 secs	Int	Int	Int	Int
1 sec	5.7	Int	Int	Int
4 secs	9.5	5.7	Int	Int
16 secs	---	9.5	5.7	Int

Int = Internal battery

Capacity in A.h.

Capacities assume two external transducers, each at 20mA.

TABLE 1

INTERNAL BATTERY (1.8 A.h.) - Capacity in Weeks

Analogues at 100%

	TRANSMISSION INTERVAL (Mins)				
	0.5	2	4	16	
TRANSDUCER	0.25	5.3	12.3	15.9	20.2
SETTLING	1	2.4	7.2	10.9	17.6
TIME	4	0.7	2.7	4.8	11.7
(seconds)	16	0.2	0.8	1.5	5.0

Analogues at 0%

TRANSMISSION INTERVAL (Mins)					
		0.5	2	4	16
TRANSDUCER	0.25	8.6	15.9	18.5	21.2
SETTLING	1	4.6	11.3	15.0	19.8
TIME	4	1.6	5.2	8.5	15.8
(seconds)	16	0.4	1.7	3.1	8.7

TABLE 2 - BATTERY CAPACITY - INTERNAL BATTERY

EXTERNAL BATTERIES - Capacity in Weeks

3.0 A.h. Battery

Analogues at 100%

		TRANSMISSION INTERVAL (Mins)			
		0.5	2	4	16
TRANSDUCER	0.25	8.6	19.3	24.4	30.5
SETTLING	1	3.9	11.6	17.2	26.9
TIME	4	1.2	4.4	7.8	18.4
(seconds)	16	0.3	1.3	2.5	8.1

Analogues at 0%

		TRANSMISSION INTERVAL (Mins)			
		0.5	2	4	16
TRANSDUCER	0.25	13.7	24.5	28.2	31.8
SETTLING	1	7.4	17.8	23.2	30.0
TIME	4	2.6	8.5	13.5	24.4
(seconds)	16	0.7	2.7	5.1	13.9

TABLE 3a - BATTERY CAPACITY - 3.0 a.h. BATTERY

5.7 A.h. Battery

Analogues at 100%

TRANSMISSION INTERVAL (Mins)					
		0.5	2	4	16
TRANSDUCER	0.25	15.4	32.4	39.7	47.8
SETTLING	1	7.2	20.4	29.2	43.1
TIME	4	2.3	8.2	14.1	31.0
(seconds)	16	0.6	2.4	4.6	14.5

Analogues at 0%

TRANSMISSION INTERVAL (Mins)					
		0.5	2	4	16
TRANSDUCER	0.25	23.7	39.8	44.8	49.5
SETTLING	1	13.4	30.1	37.9	47.2
TIME	4	4.9	15.2	23.5	39.6
(seconds)	16	1.4	5.1	9.3	24.1

TABLE 3b - BATTERY CAPACITY - EXTERNAL 5.7 a.h. BATTERY

9.5 A.h. Battery

Analogues at 100%

TRANSMISSION INTERVAL (Mins)					
		0.5	2	4	16
TRANSDUCER	0.25	23.7	46.3	55.0	64.0
SETTLING	1	11.6	30.7	42.3	58.9
TIME	4	3.8	13.1	22.0	44.5
(seconds)	16	1.0	4.0	7.5	22.6

Analogues at 0%

TRANSMISSION INTERVAL (Mins)					
		0.5	2	4	16
TRANSDUCER	0.25	35.3	55.0	60.7	65.8
SETTLING	1	20.9	43.4	52.9	63.3
TIME	4	8.0	23.5	34.9	54.9
(seconds)	16	2.3	8.3	14.8	35.8

TABLE 3c - BATTERY CAPACITY - EXTERNAL 9.5. a.h. BATTERY

SPARES LIST

Order Item by type No.

ANALOGUE INPUT DAUGHTER BOARDS

YPE No	INPUT SPAN	APPLICATION
AD31	0-7 to 0-35mV	Pressure transducer (5V energisation)
AD32	0-25 to 0-75mV	: : :
AD33	0-10mA	2/3 wire transmitter
AD34	4-20mA	: :
AD35	0-5V	Potentiometer
AD36	1-5V	Transducer

BATTERY

B37 Supplementary rechargeable 5.7 A.h. battery housed in plastic weatherproof enclosure.

SOLAR PANELS

M5 Nominal 5w panel with fittings to mount on 2" diameter pole.

M10 Nominal 10w panel with fittings to mount on 2" diameter pole.

AERIALS

SA10 Stub aerials for direct mounting on Tx and Rx cases.

ENF450 End fed dipole, excluding cable.

UHF4 4-element Yagi (7.5db gain), excluding cable.

UHF8 8-element Yagi (10db gain), excluding cable.

Downlead cable, length to be specified with order.

CO2 Pole clamps for fixing Yagis to 2" diameter pole.

CSN6 Wall mounting bracket for ENF450.

A range of aerial poles and fittings is available.

TABLE 4