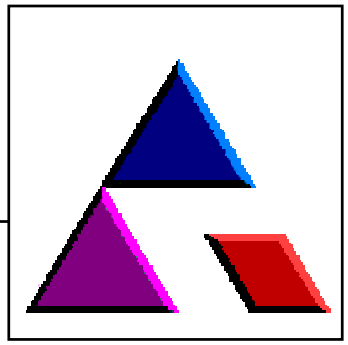
ALPHR TELEMETRY



LANDMARK TRANSMITTER

Technical Manual

Issue 2 : September 2001

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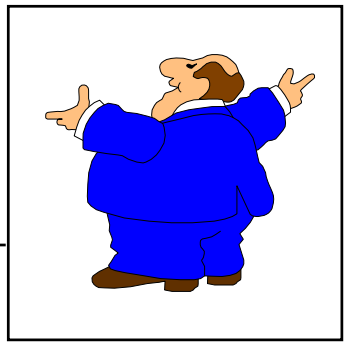
Introduction

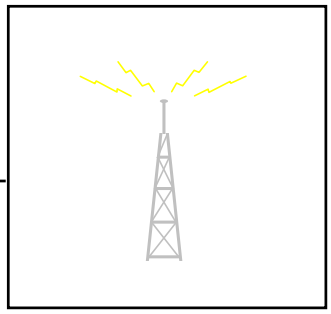


The transmitter collects instrument signals at the point of measurement and then converts them into a form for secure transmission over the radio link.
These signals can be a combination of analogue, digital and pulse information.
The transmitter also adds information concerning its own address, error detection coding and battery condition.

The transmitter undergoes extensive diagnostic routines when it is initially powered up and at each subsequent reading. Details of these features are included in the Fault Finding & Diagnostics section of this manual.

The basic transmitter is capable of providing one channel of information consisting of one analogue and eight digital signals, or one analogue, six digital and two pulse signals.
Should more than one channel of data be required to be transmitted, the basic transmitter can be expanded. Details of the transmitter expansion system are contained within the 'Expansion Options' section of this manual.
Should more than 256 channels of data be required, additional radio frequencies may be utilised.

Operation



The transmitter is normally in a dormant state which consumes very little current.
In this state the unit performs only one task which is to operate its internal clock.
This clock may be set by the user and causes the the transmitter to wake up at predefined intervals.
On wake-up the unit reads its inputs, performs a self diagnostic test, reads its address, checks its battery level and then compiles all this information into a secure data packet which is then transmitted.

In addition to the operation at fixed time intervals, the transmitter also supports alarm functions. If any digital input changes state then the internal clock is immediately overridden and the transmitter sends its message.
Similarly, either pulse input overrides the internal clock if there is a change of greater than 10% of its full scale reading.

Each data packet is transmitted a total of five times. There is a random delay introduced between these five transmissions which ensures correct interleaving of signals when there are more than one transmitter on the site or in the area.

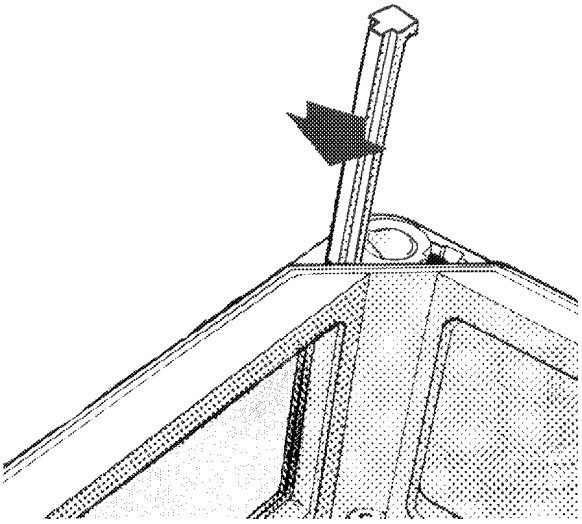
Installation and Setup

The standard Landmark enclosure is sealed to IP65 making it suitable for mounting directly onto a wall without further protection.

Mounting is achieved via a hole in each corner of the base.
To access these the user must remove the lid by giving a quarter-turn anticlockwise to each of the four lid retaining screws. This will cause them to pop up and release the lid.

To retain the IP65 rating of the box, all cables must be glanded through the removable gland plates.
Removal of the gland plate is achieved by withdrawing the retaining lugs from either end of the plate using a flat bladed screwdriver as shown in Fig.1.
Re assembly is the reverse of removal but may require slight pressure on the side plates whilst the retaining lugs are being re-inserted.

Fig.1



The units have been designed to minimise installation. Access to the terminal connections can be gained by removing the side plates to the box. The connection block can then be detached by removing the 26 -way IDC leads and unclipping the terminal board. Necessary interconnections may then be made outside of the enclosure. Only when the wiring is complete need the side plate and terminal board be refitted.

The process of setting up requires little or no effort in most cases and is dealt with individually in the respective output option sections.

The main user settable options are the transmitter address, the receiver (2nd) address and the report rate.
These are set by the three switches mounted at the side of the transmitter board as shown in Fig.2 below.
Left to right they are : 'Report rate', 'Address' and '2nd'. The function of these is detailed overleaf.

Fig.2

The address must be unique for any one transmitter.
It may be set on the ‘Address’ rotary switch from 0 to F (i.e.. 0 to 15 decimal).

The addressing can become complicated for large expanded systems where more than two channels of information is to be transmitted, however in these cases they will be set at the factory on system test or by Alphr installation personnel and should not be altered.

For smaller systems of one or two channels, the standard is to address the first channel as 0 and the second channel as 1.

The switch on the board marked ‘2nd’ defines a secondary address which is in effect the receiver or ‘system’ address.
A receiver will only mimic data received from transmitters with the a 2nd address matching that set on its own address switch.
This can be used to give give a link its own identity in an area of heavy radio usage.

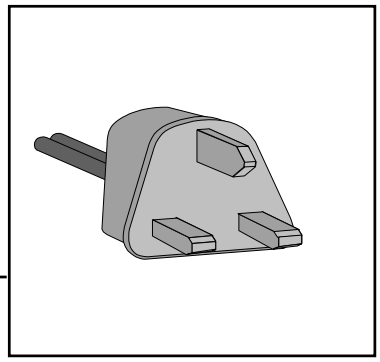
Thus for a simple 1 channel link, the address would be set to 0,
and the 2nd switch may be set to anything - so long as the receiver switch is set to the same and there are no other systems with the same 2nd address within range.

A transmitter wakes up at a predefined time, according to the setting of the rate switch.

Periods range from 15 seconds to 16 minutes as defined below:

Switch position	Report rate
0	15 secs
1	30 secs
2	45 secs
3	1 min
4	2 mins
5	3 mins
6	4 mins
7	5 mins
8	6 mins
9	7 mins
A	8 mins
B	9 mins
C	10 mins
D	12 mins
E	14 mins
F	16 mins

Power Supplies



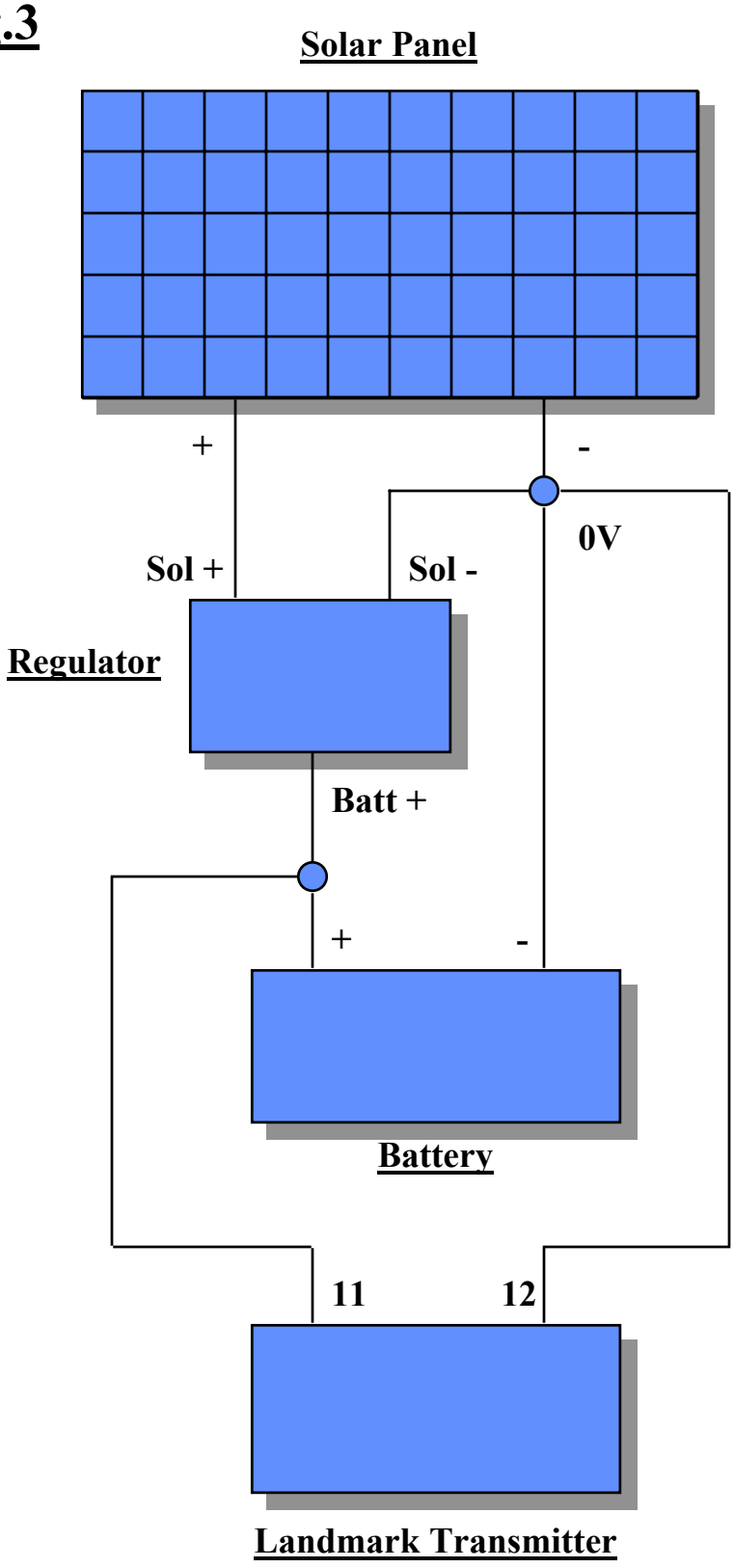
The transmitter unit will, unless otherwise specified, be fitted with a power supply module.
Connection to this is via the 3-pin IEC socket on the psu itself. 3 core cable may then be run outside the enclosure through a cable gland in the gland plate.

The power supply is factory set to accept 240V at 50Hz unless otherwise specified. 110V input may be selected by a switch on the circuit board of the psu itself, so alteration may require slight disassembly of the unit.

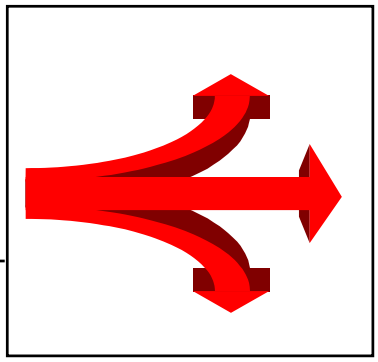
If the unit is ordered without a mains psu, it may be operated from +12 to +15V d.c.. This is applied as shown in Fig3 , +12V to pin 11, 0V to pin 12.
In areas where power cannot be readily supplied, the Landmarks can work off a solar supply due to their low quiescent current and selectable report rate.
Before specifying a solar supply, the user should take account of location, report rate required, radio power required, available antenna height and size of solar panel. Alphr Telemetry can calculate and supply the required rating of solar panel , battery & regulator.
The wiring for a solar supplied system is shown overleaf in Fig.3.

Supplying power to the unit will cause operation - there is no on/off switch. The psu is working correctly if the unit starts transmitting - indicated by the green led on the controller board flashing periodically accompanied by the relay clicking.
Once the power is supplied to the unit, a switched power supply will be available to supply excitation current to outstations/sensing equipment. This is available on terminal 21 of the connector shown in Fig 4. This supplies +12V for a period shortly before the transmitter reads the inputs. The maximum output current from this supply is 250mA.

Fig.3

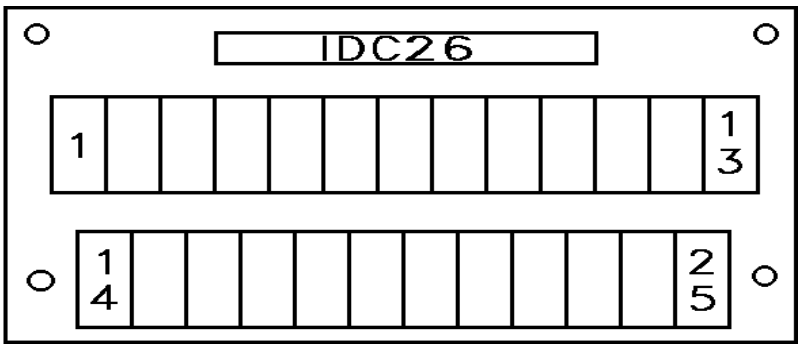

Solar Panel
+
-
0V
Sol +
Sol -
Regulator
Batt +
+
-
Battery
11
12
Landmark Transmitter

Input Connections



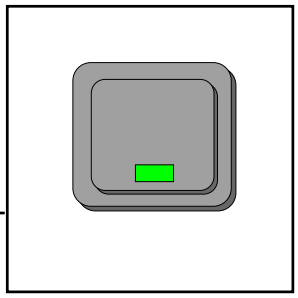
All power and instrument signals as well as RS423 communications lines are available at the 25 way connector block .
This is shown with the pin designations below:

Fig.4



Pin	1	Digital input 0	Pin	14	Pulse count 0
	2	Digital input 1		15	Pulse count 1
	3	Digital input 2		16	Ground
	4	Digital input 3		17	Ground
	5	Digital input 4		18	Ground
	6	Digital input 5		19	Ground
	7	Digital input 6		20	Ground
	8	Digital input 7		21	Switched 12V
	9	RS423 Transmit		22	5V out
	10	RS423 Receive		23	12V DC in
	11	+12V DC in		24	0V DC in
	12	0V DC in		25	Analogue -
	13	Analogue +			

Digital Inputs



The standard transmitter allows 8 digital inputs to be connected. These are defined on the connector diagram shown previously on pins 1 to 8 for digital inputs 0 to 7 respectively.

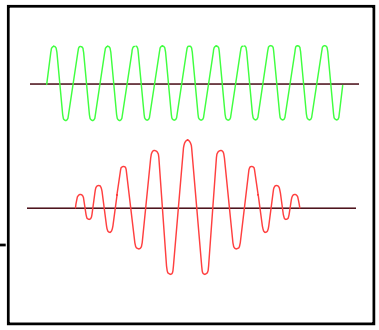
These inputs are active low.

They are pulled up to +5V d.c. internally via a 100kOhm resistor and are RC filtered to debounce them with a time constant of 470uS.

Connecting an input to ground will assert the relevant input.
This may be done either through a volt-free contact (relay etc...) or by open collector/TTL level drivers.

A number of ground pins are available on the input connector for use with the digital inputs.

Analogue Input

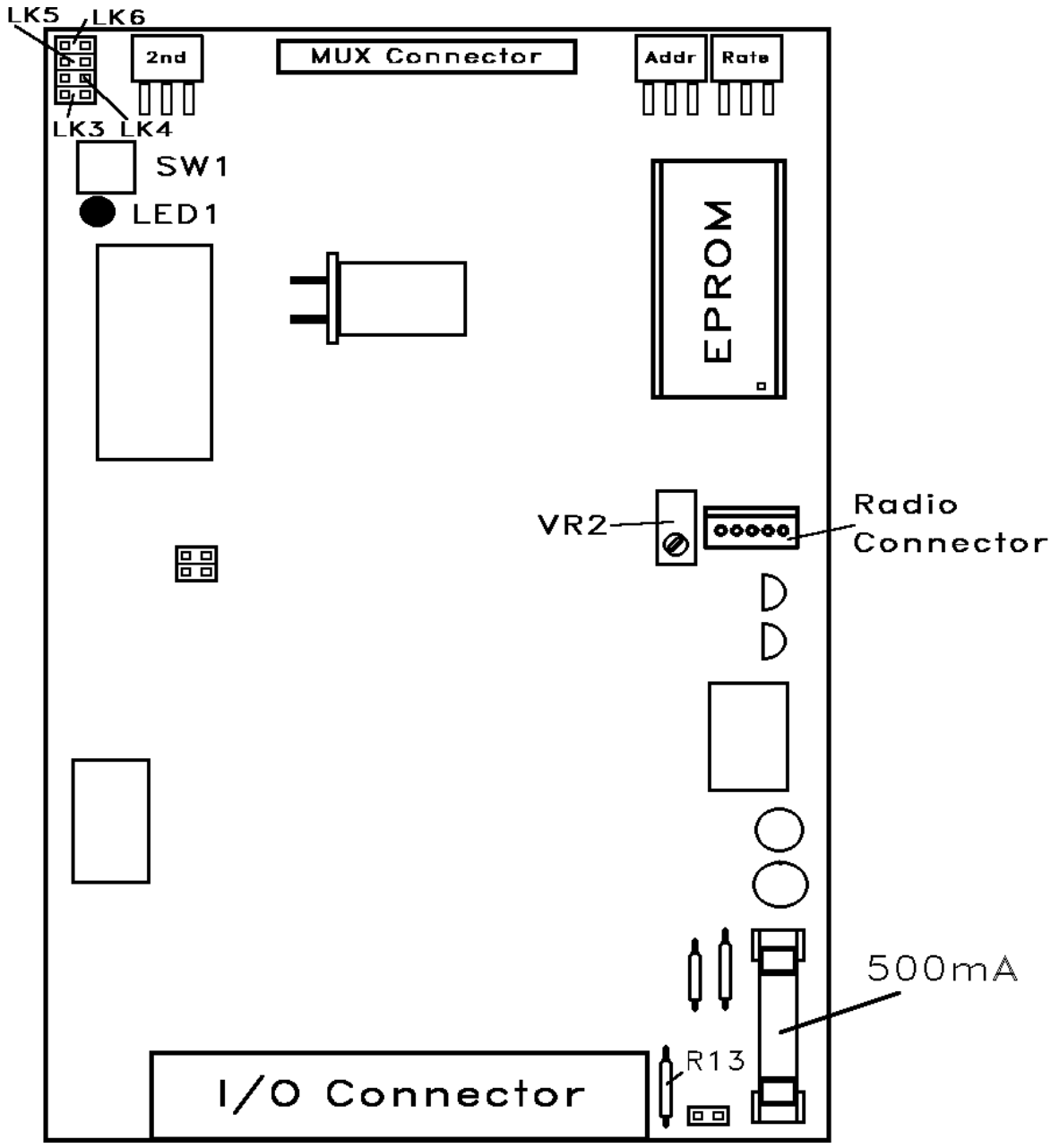


A standard transmitter allows a single analogue input which is then transmitted as data over the radio link.

This can operate in either a current or voltage mode over a variety of ranges.

The following pages describe the procedure for setting up these ranges with reference to the transmitter card layout shown overleaf in Fig.5.

Fig.5


LK5
LK6
LK3
LK4
2nd
MUX Connector
Addr
Rate
SW1
LED1
EPROM
VR2
Radio
Connector
500mA
R13
I/O Connector

Voltage input :

An input voltage may be applied across the A+ and A- terminals of the input connector. A- may be tied to ground if required for absolute voltage input.
This is then converted into an 8-bit reading giving a count of 0 to 255 which will be the value transmitted.

The full scale voltage may be set in the range 1V to 5V as desired.
Note that if the A+ input pin rises above 5.5V with reference to ground, or the A- pin falls below -0.5V then the reading will be subject to non-linearity errors.

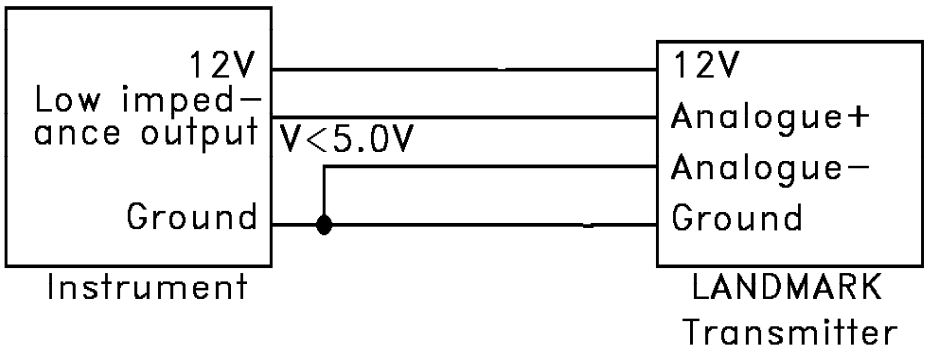
To set voltage operation the following settings must be made with reference to the transmitter card layout shown previously:

Remove sense resistor R13
Short LK5

then follow the calibration procedure detailed later in this section of the manual.

Recommended connection is as shown below:

Fig.6



Current input :

An input current may be applied across the A+ and A- terminals of the input connector.
This is then converted into a voltage by a sense resistor resulting in an 8-bit reading giving a count of 0 to 255 which will be the value transmitted.

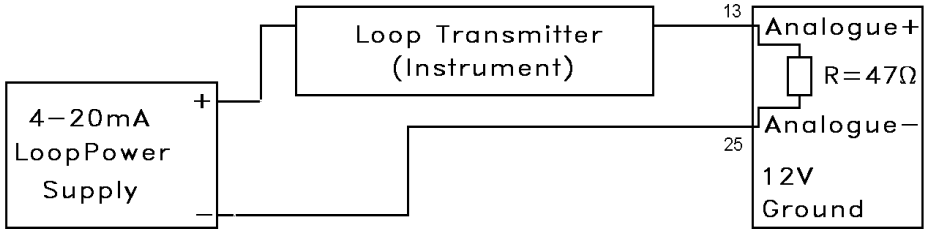
The full scale input may be set in the range 0mA to 20mA as desired. Note that if the A+ input pin rises above 5.5V with reference to ground, or the A- pin falls below -0.5V then the reading will be subject to non-linearity errors.

To set voltage operation the following settings must be made with reference to the transmitter card layout shown previously:

For 0-20mA inputs Short LK5
For 4-20mA inputs Leave LK5 open circuit

then follow the calibration procedure detailed later in this section of the manual.
Recommended connection is as shown below:

Fig.7



Analogue setup :

The analogue to digital converter is laser trimmed to provide very high linear accuracy when referred to a mid-scale reading.
For this reason, the Landmark software includes a calibration facility around the mid scale reading for the range required.

The calibration procedure is as follows:

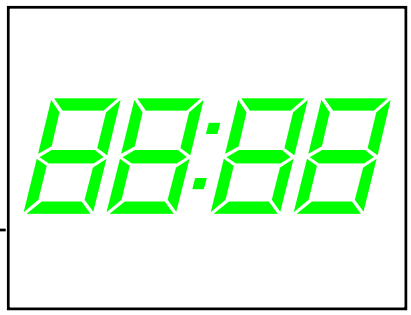
Remove the antenna from the outside of the Landmark box
Connect power to the transmitter
The led should light and the relay will click 5 times and then stop.
Press the push-button SW1
Connect the analogue input and apply a half full scale current or voltage.
If the led is off, adjust VR2 clockwise until the led begins to flash.
If the led is on, adjust VR2 anticlockwise until the led flashes.
Fine tune VR2 for maximum flash rate.
This has now calibrated the analogue input.

Remove power to the transmitter and re-connect the antenna.
Now, when powered up, the transmitter will resume normal operation.

It is also possible to perform this calibration using a serial terminal.
This should be connected to the serial lines shown on the input connector diagram previously.
If the user follows the above procedure, except, where the push-button would normally be pressed, the user should type ‘SETUP’.
The user may then follow the instructions on the screen.

Note that the serial I/O on a transmitter is at RS423 TTL levels, so to use with a terminal or PC an RS232 converter will be required.

Pulse Count Inputs



The transmitter can accept two pulse inputs.

These record pulses then transmit the count.
The count is sent as an absolute value each time so that in the rare event of the data not being received, no deficit will occur at the receiver end.

Each pulse count input is active low, RC filtered and debounced.
They are asserted in exactly the same way as the digital inputs detailed previously.

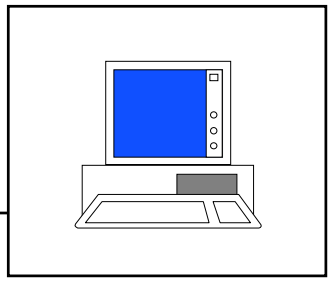
The minimum pulse width is 2mS. There is no maximum pulse width.

Each counter has a capacity of 16 bits and could therefore overflow if the pulse rate is high and the report rate slow.
To remove this risk, the transmitter will automatically transmit its count if a rate of 10% full scale is encountered since the last transmission..

Recommended rates are typically <25 pulses per second with a report rate of 4 minutes.

There are no setup procedures required to use the pulse count inputs.

Serial Input



The serial input is a standard feature of all transmitters although is used mainly for diagnostic and setup purposes.

The serial port is located on the transmitter input connector.

The relevant pins on the connector are as shown below:

Pin 9	Transmit
Pin 10	Receive
Pin 16-20	Ground

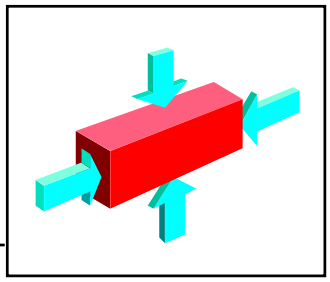
The format of the data at the serial port is fixed as follows:

- 9600 baud
- 8 data bits
- 1 stop bit
- no parity.

No handshaking is used.
The signal is at RS423 TTL data levels.

The serial input may also be used to transmit data from a PC software package via the radio link to operate controls at the receiver end as opposed to hard wiring process inputs into the transmitter.
To allow this, the transmitter card must be specially configured and certain serial protocols must be observed.
Contact Alphr for details if this option is required.

Expansion Options

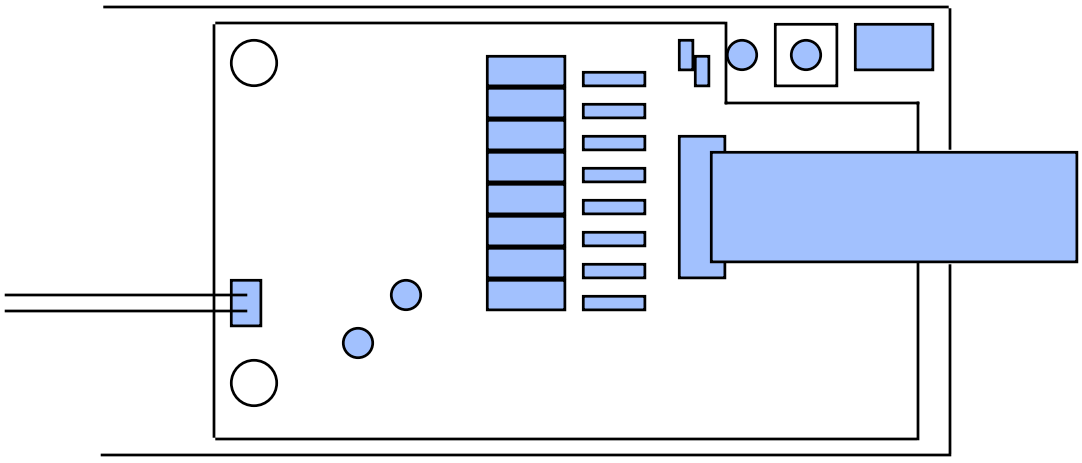


The standard Landmark transmitter will accept 8 digital and 1 analogue input , or 6 digital, 2 pulse and 1 analogue input .
If more inputs are required, a multiplexer is plugged onto the main controller board and extra connector boards are utilised .
The multiplexer board is populated to the level required and can increase the input capacity of the Landmark transmitter as follows :

Analogue inputs : 2 , 4 or 8
Digital inputs : 16 , 24 or 32.

A diagram of the multiplexer board is shown below in Fig 8.
The user should note whether a multiplexer is fitted as this will affect the wiring and setup of the transmitter unit.

Fig.8

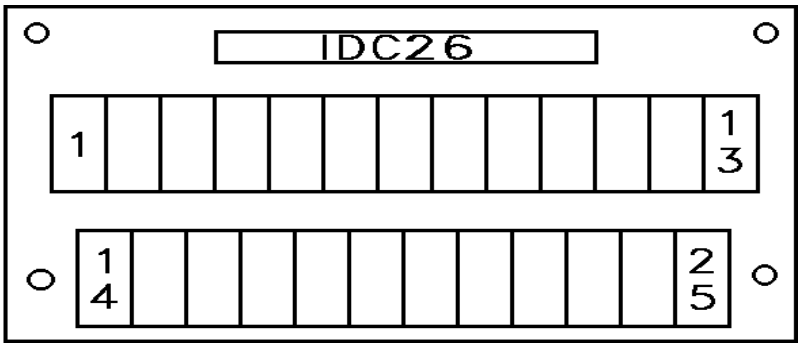


The same connector blocks are used regardless of whether the multiplexer is used for adding extra digital inputs, analogue inputs or both.

Fig.9 overleaf shows the input connector, together with the pins used for the relevant expansion options.

It should be noted that, for expanded digital inputs, a change in state of one of these inputs will not cause the transmitter to transmit immediately, as would be the case for Digitals 0-7 on a basic transmitter.
The state of the expanded digital inputs will be transmitted at the interval set by the ‘Rate’ switch as detailed in the ‘Installation & Setup’ section of this manual.
The base 8 digital inputs will still be available however, and these will still cause a transmission if changed.

Fig.9



	2 - 8 Analogues	16 Digitals	24 Digitals	32 Digitals
Pin 1	Analogue 0 +	Digital 8	Digital 16	Digital 24
2	Analogue 1 +	Digital 9	Digital 17	Digital 26
3	Analogue 2 +	Digital 10	Digital 18	Digital 26
4	Analogue 3 +	Digital 11	Digital 19	Digital 27
5	Analogue 4 +	Digital 12	Digital 20	Digital 28
6	Analogue 5 +	Digital 13	Digital 21	Digital 29
7	Analogue 6 +	Digital 14	Digital 22	Digital 30
8	Analogue 7 +	Digital 15	Digital 23	Digital 31
14	Analogue 0 -	N/C	N/C	N/C
15	Analogue 1 -	N/C	N/C	N/C
16	Analogue 2 -	Ground	Ground	Ground
17	Analogue 3 -	Ground	Ground	Ground
18	Analogue 4 -	Ground	Ground	Ground
19	Analogue 5 -	Ground	Ground	Ground
20	Analogue 6 -	Ground	Ground	Ground
21	Analogue 7 -	Ground	Ground	Ground

Expanded Analogue setup

Each analogue input on the multiplexer board has its own sense resistor and calibration pots. allowing each input to be individually set up as required. For this reason, when a multiplexer is used for extra analogue inputs, the sense resistor R13 on the main transmitter board should be removed. (Refer to Fig.4 earlier in this manual for the location of R13.)

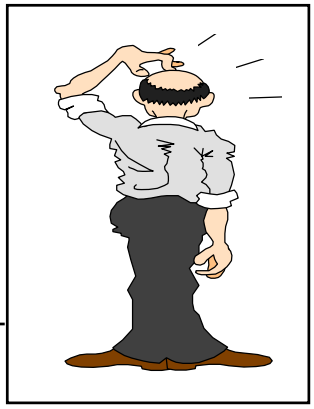
The calibration sequence for the analogues on the multiplexer board is as follows :

Remove the antenna from the outside of the Landmark box.
Using the 'Add.' rotary switch on the transmitter board, select 0-7 corresponding to the channel of the multiplexer to be calibrated (i.e. Channel 0 = 0 , channel 1=1 etc..).
Connect power to the transmitter.
The led should light, the relay will click 5 times then stop.
Press the pushbutton SW1 on the transmitter board.
Connect the analogue input for the required channel and apply a half scale value (e.g. 10mA if using 4-20mA range).
If the led is off, adjust the calibration pot. on the required channel clockwise until the led begins to flash.
If the led is on, adjust the calibration pot. on the required channel anticlockwise until the led begins to flash
Adjust for maximum flash rate.

This may be repeated for each analogue channel by incrementing the rotary switch, then moving the analogue input along to the next channel.

Should the led not flash, it may be necessary to adjust the 'Anlg' pot - visible through the hole in the multiplexer board - one quarter turn clockwise. The above calibration process can then be repeated.

Fault Finding & Diagnostics



Since the transmitter is designed to replace hard wired links and convey data invisibly over radio, there is little to ‘see’ in order to fault find if data appears not to be transmitted and evaluating whether a fault lies at transmitter or receiver.

Ideally, a radio scanner or power meter set to the frequency at which the radio is operating should be connected in line with the antenna to determine whether the radio is actually transmitting the data or not.

When the transmitter wakes up and transmits, the green led will illuminate momentarily, accompanied by a relay on-off click.
The relay switches the 12V supply onto the radio via the red wire from the radio connector. Data is then fed into the radio via the blue wire.

Using a known good receiver, and/or another known good transmitter it should be possible to evaluate whether the fault is with the transmitter or receiver.
Please refer to the Landmark receiver user manual for fault finding information on the receiver.

To aid with the above process, if link LK3 on the transmitter board is shorted, and the pushbutton is pressed, this will cause the transmitter to constantly transmit random messages.
When using this feature, the antenna should be disconnected to ensure the random messages to not have any adverse effects on other systems within range.

Should a test be required without disconnecting the antenna, maybe to evaluate the antenna connections, if the push-button is pressed without LK3 shorted, the transmitter will transmit a constant tone which may be monitored.

The radio unit within the Landmark unit is replaceable should it fail, however there are no user-adjustable parameters within it, and it must not be altered in any way as this could cause the system to transmit illegally.

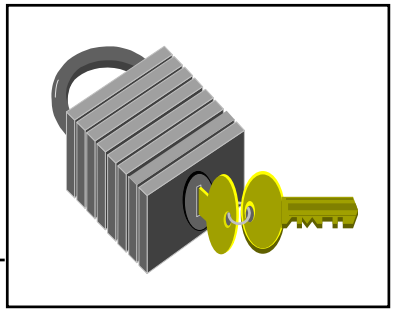
If a terminal is available it may be connected as detailed previously.
On power-up the transmitter software performs extensive self diagnostic tests.
If any of these fail, an error code will be reported on the terminal.
These codes are as follows:

01	RAM read/write failure
02	ROM checksum failure
03	Watchdog reset failure
08	ADC read failure
10	Pulse counter reset failure
20	Multiplexer selection failure
40	Unknown reset occurred
80	Software trap occurred

If several errors occur, the reported code is the sum of all errors encountered.

A step by step guide to troubleshooting for the Landmark transmitter can be found in Appendix II at the back of this manual.

Data Security



The information transmitted by Landmark is supplemented by check bits in order to protect messages against interference and also synchronised by means of a preamble.

The Cyclic Redundancy Check code used is the widely accepted X16 which gives a residual error probability of 1 in 10E-14.

It can then be calculated that the Landmark data transmission system , when used in its fastest transmission mode of 5 packets every 15 seconds, will produce an average time between undetected errors of 936 years.

These calculations show that the equipment conform with the IEC guidelines on telealarming, telemonitoring and telecontrol.

A copy of the full calculation procedure is available on request.

Recommended Spares

Whilst at no point during the first 10 years of operation do we expect the Landmark equipment to fail for any reason , due to the often process critical nature of its applications, it can be prudent to carry spares of major boards and components.

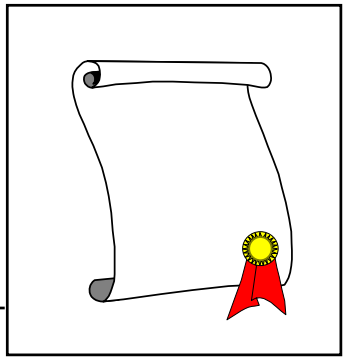
This list also acts as a guide if boards are required to upgrade or expand an existing system.

Transmitter Controller card
Transmitter Power supply unit
Multiplexer board (if fitted)
Transmitter radio
Input connector board

All parts except radios are available ex-stock from Alphr Telemetry - radios are approximately 2-3 weeks delivery.

As the Landmark system can be built to numerous levels of inputs/outputs, radio frequencies etc.., the original Alphr reference should be noted to ensure the suitability of any spares supplied.

Conformance



In the United Kingdom, Landmark units are, as standard, type approved to MPT1329 and, as such, do not require an operating licence.
Also available among others are units type approved to MPT1328 and the rigorous German FTZ regulations.

The structure of the protocol used to transmit the data across the airwaves conforms with the following standards :

IEC 870 Part 5

Class I :	Telemetering
Class II:	Teleindication
Class III:	Critical information transmission and Telecommand.

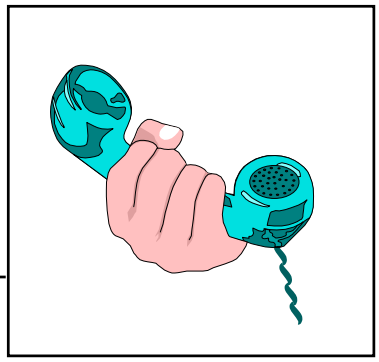
In addition to this, the Landmark system also performs various data checks as detailed in IEC870 Part 4 , which improve data integrity still further.

This specification has now been ratified to British Standards as follows :

IEC 870 Part 4	=	BS7404 Part 4
IEC 870 Part 5	=	BS EN 80670 Part 5

The Landmark product is CE marked.

Technical Support

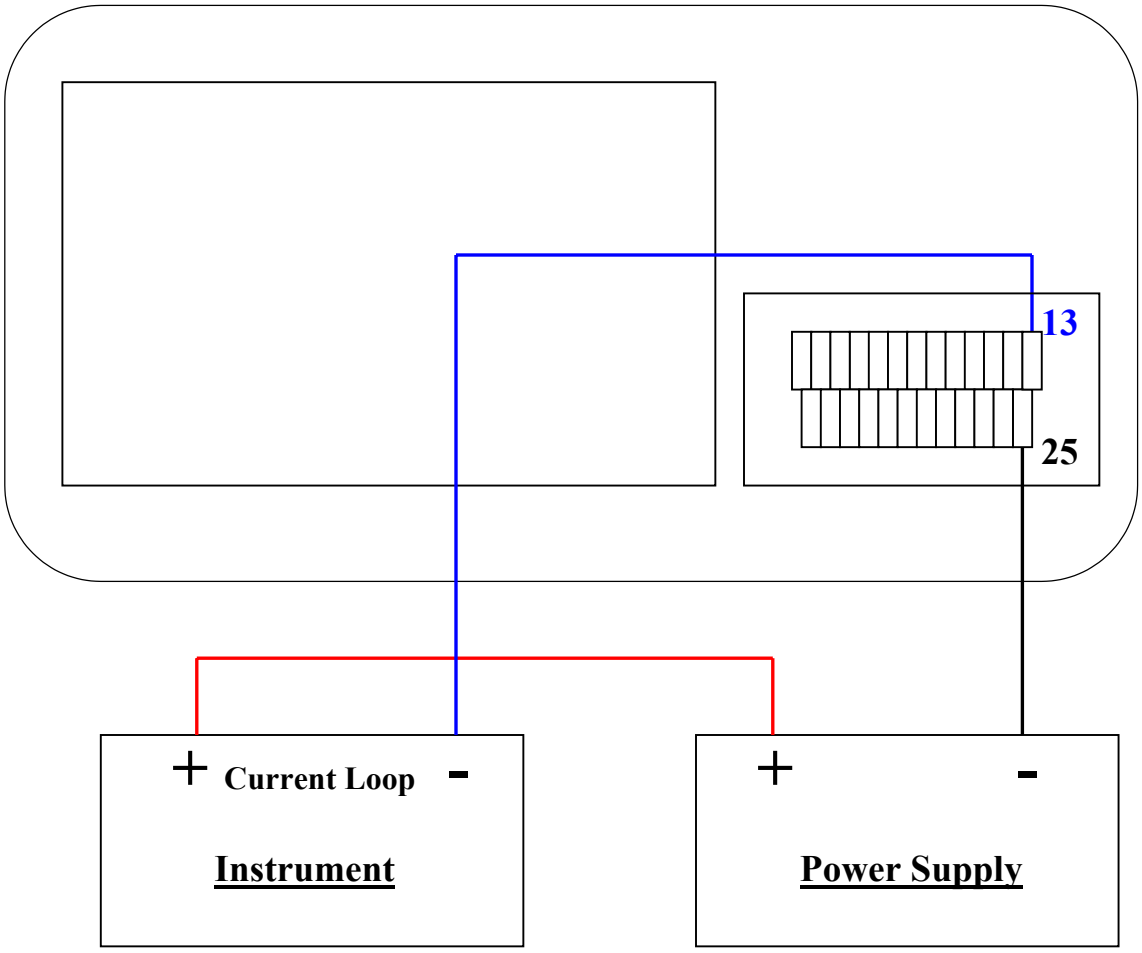


ALPHR Telemetry back the Landmark products with a full range of compatible products and services.
These include test equipment, radio site surveys to establish radio requirements for a given application and full installation if required.

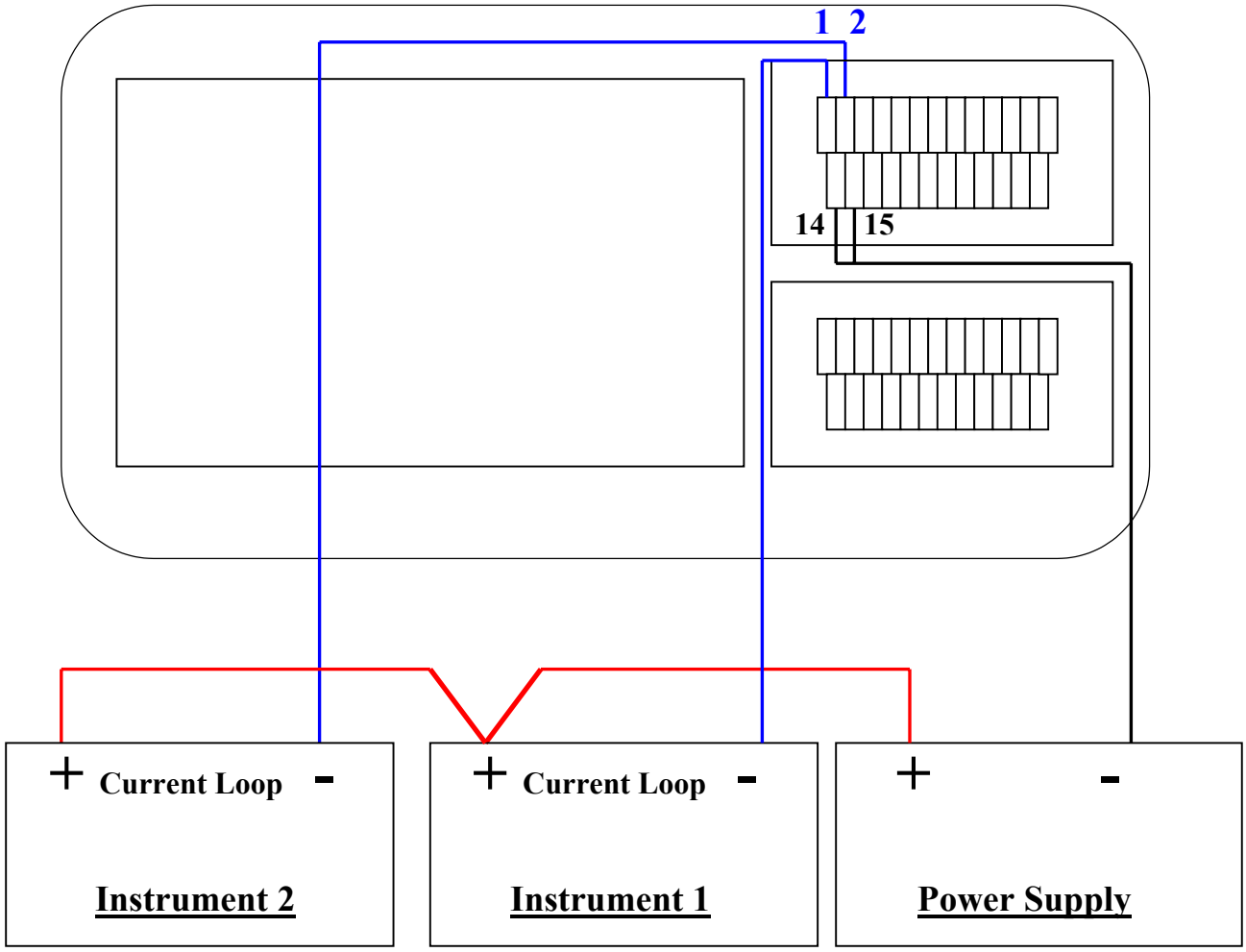
For more details or assistance in installation or operation of the Landmark system, contact ALPHR Telemetry at the following addresses:

Head Office : Customer Support Manager
25 Tower Quays
Tower Road
Birkenhead
Merseyside CH41 1BP

Telephone : 0151 647 6003
Fax : 0151 650 2008



CONNECTION OF SINGLE ANALOGUE INPUT



CONNECTION OF MULTIPLE ANALOGUE INPUTS

BASIC FUNCTIONAL TROUBLESHOOTING GUIDE ON STANDARD TRANSMITTER IN FIELD.

NO SIGN OF ACTIVITY.		***REMEDY***
No relay clicking sound or flashing green LED on power up.	→	If it looks & sounds OK Go to Sheet 2.
↓		
Is power on? (check with DVM on mains lead moulded socket)		
↓		
Check PSU setting (if present) (110V or 240V switchable) plate.	→	Re-set if required. Access via top gland
↓		
Is power lead inserted in PSU socket?	→	Insert.
↓		
Is D plug inserted (LH side of board)?	→	Press home.
↓		
Check 12V supply on pins 11(+) & 12(-) of digital input board. board.	→	Check PSU fuse & fuse on transmitter
↓		
Check IDC plug fully inserted into digital input board (WSX 98001)	→	Press home.
↓		
Transmitter board or wiring loom U/S	→	Return unit to Alphr or seek service.
↓		

TRANSMITTER SHEET 2.

		REMEDY.
Transmitter seems to come to life but nothing received on receiver.	→	If transmitter seems to work apart from an analogue, follow the Transmitter Calibration Procedure. If digital problem,check input connections.
↓		
Is D plug fully inserted into radio module?	→	Press home.
↓		
Is white plug inserted into transmitter board?	→	Press home ensuring correct mating.
↓		
Is gold coax plug fully tight on radio?	→	Tighten, ensuring plug & socket do not rotate together.
↓		
Is external BNC socket clean and dry?	→	Clean & thoroughly dry.
↓		
Is transmitter connected to serviceable antenna and feeder cable?	→	Replace with known gooditems.
↓		
Is the frequency of the transmitter radio same as on receiver radio?	→	Contact Alphr.
↓		
Does 2nd address switch setting match the address switch setting on receiver board? (see manuals)	→	Make it match.
↓		
If all above OK, then a known good receiver will have to be placed next to transmitter (within 1 to 2 metres)	→	Follow Receiver Troubleshooting Procedure

TRANSMITTER SHEET 3.

REMEDY.

USE KNOWN GOOD RECEIVER

Remove antenna from transmitter.
Set transmitter 1st address switch to 0 and 2nd address switch to match receiver address. Set report rate switch to 0.

↓

Simulate digital signal by connecting pin 1 to pin 16 on digital input board and/or inject analogue input.

↓

Transmitter relay should click 5 times and LED flick on 5 times. Receiver LED should flick on 5 times in response. (3 or 4 will do). Digital 0 LED should light and/or analogue output. (Assuming relay output board fitted in receiver. → If receiver LED active but no output, try different 2nd Address on transmitter& matching address on receiver. Also try different digital input.

↓

If transmitter fails above, then connect a terminal to RS232 output on receiver and monitor data packets as per manual. → If terminal not available return return transmitter to Alphr or call for assistance.

↓

Monitor data packets as per manual.