COBHAM

LDR Link User Manual

Version 1.4
16 April 2009

1   Table of Contents

2 Change History

Version	Main Changes from Previous Version	Edited By
v1.0	Initial Release	MB
V1.1	Added comments to range tests	MB
V1.2	Added LDR Receiver, removed support for Stream view software decoder	MB
V1.3	Added connector types	MB
V1.4	Correct error on data pin out	MB

3 About this Manual

This manual describes the operation of domo LDRLink (Low Data Rate Link) wireless system. The manual is divided into three main sections.

- **Getting started and basic operation**

  This section describes to users how to deploy and use a LDR Link system.

- **Advanced operation**

  This section describes the operation of the system in more detail, concentrating particularly on how to store and recall configurations, with use of the PC Controller Application.

- **Technical reference**

  This section provides technical specification and control protocol data and will be of interest to those integrating the LDR Link system into larger systems.

4   Introduction

This document constitutes the handbook for the LDR Link transmitter product, and the 'StreamView' PC viewing application. This Handbook should be read in conjuction with the SOLO4 Telemetry Handbook, for a complete system view.

The domo LDR (Low Data Rate) transmitter is a digital video transmitter, designed to operate over very long ranges. The LDR transmitter sends informational quality video at reduced frame rates, compressed to very low data rates (typically 30kb/s). This high level of compression and reduced data rate, mean that the LDR transmitter, can send images over very long distances. The LDR transmitter, occupies as little as 50KHz of bandwidth, and can therefore be used more easily at UHF frequencies. Housed in a robust water sealed enclosure and consuming only 3W, the LDR transmitter is ideal for long term out door deployments.

Security is ensured with optional AES128/256 bit encryption.

The LDR transmitter is available in a variety of frequency bands from 300MHz to 1GHZ, other frequencies are available on request.

The LDR transmitter will transmit images in a non line of sight environment up to 2km, and line of sight to 20km depending on mode and frequency, further range can be achieved with the optional clip-on booster PA.

LDR transmisions are received using the domo LDR receiver.

IMPORTANT NOTE

The LDR Link product range has been specifically designed for government security and law enforcement users, the equipment will tune across frequencies that are only available to licensed government users. Non-government users should employ the equipment restricted to the license exempt bands only typically 868-870MHz & 458MHz.

5   Warranty and Support

5.1   Warranty Cover

domo offers a 12 month standard product warranty. During this period, should the customer encounter a fault with the equipment we recommend the following course of action:

- Check the support section of the website for information on that product and any software/firmware upgrades. If fault persists;

- Call our support line and report the fault. If fault persists and you are informed to return the product please obtain an RMA number from the domo support department, and ship the equipment with the RMA number displayed and a description of the fault. Please email the support section the airway bill/consignment number for tracking purposes.

- If you have extended warranty provisions then domo will send an immediate advance replacement to you. Under most circumstances this must be returned once the fault item is repaired.

Depending on the nature of the fault domo endeavor to repair the equipment and return it to the customer within 14 days of the item arriving at our workshops.

Obviously it is impossible to cater for all types of faults and to manage 100% replacement part availability, and delays are sometimes inevitable. This is why domo recommend that its customers take out an extended warranty (which includes advanced replacement of faulty items), and/or hold a basic level of spare parts, which can be held by domo on the customer's behalf.

Please contact domo for details of packages that can be tailored to meet your individual needs, whether they are service availability, technical training, local geographic support or dedicated spares holdings.

6 Safety, Compliance and Approvals

6.1 Safe Operating Procedures

- Ensure that the power supply arrangements are adequate to meet the stated requirements of each LDRLink product.

- Operate within the environmental limits specified for the product.

- Do not subject the indoor equipment to splashing or dripping liquids.

- Only authorized, trained personnel should open the product. There are no functions that required the User to gain access to the interior of the product.

6.2 EMC / Safety and Radio Approvals

The equipment has been designed to meet and has been tested against the following harmonized EMC and safety standards:

- EN 301 489-1 & EN 301 489-5

- EN 61000-3-2:2000

- EN 61000-3-3:1995

- EN 55022:1998, Class B

- EN 61000-4-2:1995

- EN 61000-4-3:1996

- EN 61000-4-4:1995

- EN 61000-4-5:1995

- EN 61000-4-6:1996

- EN 61000-4-11:1994

- EN 60950:2000

6.3 CE marking

The CE mark is affixed to the LDRLink product, and the CE Declaration of Conformity, as well as the technical file are available on request.

7.1   Which Model do I have?

Each unit in the domo SOLO4 product range is marked with two panels.

- Product Code Panel. Give product code and manufacturers information.

- CE and Serial Number Panel. Gives CE mark and product serial number.

domo LDRTX-086087
UHF
Made in the UK
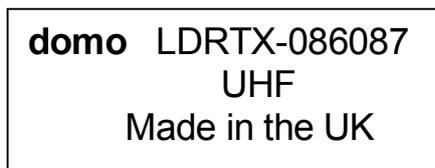
The domo product code can be referenced in the table below.

Product Code	Product	Accompanying items
LDRTX-086087	LDR Link Transmitter. 868 to 870MHz	Cables: 868MHz Omni Antenna Control Cable 2m DC Power 2m Video In Cable 2m CD with operating software and manual
LDRTX-045045	LDR Link Transmitter 457 to 458MHz	Cables: 458MHz Omni Antenna Control Cable 2m DC Power 2m Video In Cable 2m CD with operating software and manual
LDRRX-086087	LDR Link Receiver 868 to 870MHz	Cables: 868MHz Omni Antenna Control Cable 2m DC Power 2m Video Out Cable 2m CD with operating software and manual

LDRRX-045045	LDR Link Receiver 457 to 458MHz	Cables: 458MHz Omni Antenna Control Cable 2m DC Power 2m Video Out Cable 2m CD with operating software and manual

7.2 Controls

LDR Link transmitters and receivers are equipped with a standard LED (Light Emitting Diode) and push button panel. The panel is as depicted below, and the buttons and LEDs have meanings as explained in the table.
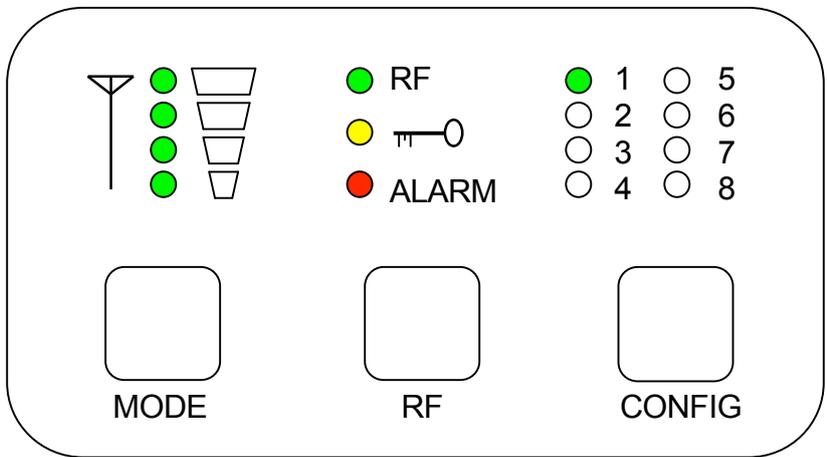
LED / Button	Colour	Meaning / Use
Alarm LED	Red	When lit indicates alarm or fault condition on equipment. (Not Currently Supported)
Front Panel Lock LED	Yellow	When lit indicates front panel is locked
RF LED	Green	Transmitter: When lit indicates RF output is active. When blinking indicates transmitter is operating in discontinuous mode and is not currently transmitting (waiting for data). (should not be used in LDRL) Receiver: When lit indicates receiver has signal lock.
LED 1 to 8	Green	Indicates which of the eight stored configurations is currently selected.
Signal Strength LED's	Green	Transmitter: Indicates output power level 5,10,15 & 20 dBm.

		Receiver:
		Indicates received signal quality.
RF Button	-	Transmitter:
		Pressing the RF button toggles the units RF output between OFF and ON.
		Transmitter & Receiver:
		Holding down button toggles unit into standby mode.
Config Button	-	The config button when pressed selects the next configuration from memory.
		Holding down button toggles front panel lock.
Mode Button	-	Transmitter:
		No Function

7.3   Getting Started with the LDR Link Transmitter

7.3.1   Cables and Connections

This section describes how to connect the following domo model numbers.

- LDRTX-086087

- LDRTX-045045

The picture below shows the domo LDR Link transmitter.

The domo LDR Link transmitter is supplied with the following cables.

- Control Cable 2m

10

- DC Power 2m

- Video input Cable 2m

The domo LDR Link transmitter should be connected as shown below.

Connect to PC for control and configuration

Connect to video source

Connect to DC power source

Antenna Connected as shown

7.3.2   DC Power Connection

The LDR Link unit can be powered from either a nominal 12V DC supply or from an external battery.

Connect the 3 pin Amphenol cable to the connector labeled 'DC IN' , taking care to align the connectors. Connect the banana connectors on the other end of the cable to a suitable DC source.

The 12V DC input has the following characteristics:

- Input Voltage Range 6V to 16V, reverse voltage protected.

- Power dissipation <3.5W

domo can supply optional AC to DC converter blocks to power the LDR Link units, please contact domo if these are required

If the unit is in standby press and hold down the RF button to power up the unit.

7.3.3   Control Connections

The 7 way Amphenol connection is used for control interfacing.

The control cable is used for Control, and is used to connect the LDR Link unit to a PC with a suitable RS232 control interface for connection to the domo PC GUI application or an embedded control application.

7.3.4   Video

Connect the video input to the Amphenol connector labeled 'Video In'.

Connector	Signal
Video BNC (on cable)	75 ohm composite video source, PAL or NTSC software selectable

Typically the video source will be a small colour or black and white CCD camera.

7.3.5   Antennas

The unit is supplied with 868MHz (or 458MHz) omni-directional flexible antennas as standard. These should be screwed directly to the panel mount TNC RF Out connector. Care should be taken to not over tighten the antenna. It is recommended that the transmit antenna should be connected directly to the unit and not via a cable. Any cable in this position will reduce the range performance of the equipment.

Important Note: The supplied antennas are dipole antennas and do not require a ground plane. Users might wish to use other antennas, such as directional antennas for greater range.

Additional antennas may be ordered from domo. For longer range, more specialized antennas such as Yagis can be supplied.

7.3.6   Installation notes

The domo LDR Link transmitter is supplied in a rugged chassis with mounting holes for ease of integration. It is designed for simple integration into any system.

The LDR Link transmitter can be mounted in an outdoor situation. In an outdoor situation care should be taken to mount the unit with the connectors pointing downwards. The cable connectors must be protected by the drip ledge.

7.4   Getting Started with the LDR Link Receive System

7.4.1   Cables and Connections

This section describes how to connect the following domo model numbers.

- LDRRX-086087

- LDRRX-045045

  The picture below shows the domo LDR Link receiver.

  The domo LDR Link receiver is supplied with the following cables.

- Control Cable 2m

- DC Power 2m

- Video input Cable 2m

  The domo LDR Link receiver should be connected as shown below.

Connect to PC for control and configuration

Connect to video monitor

Connect to DC power source

Antenna Connected as shown

7.4.2 DC Power Connection

The LDR Link unit can be powered from either a nominal 12V DC supply or from an external battery.

Connect the 3 pin Amphenol cable to the connector labeled 'DC IN' , taking care to align the connectors. Connect the banana connectors on the other end of the cable to a suitable DC source.

The 12V DC input has the following characteristics:

- Input Voltage Range 6V to 16V, reverse voltage protected.

- Power dissipation <3.5W

domo can supply optional AC to DC converter blocks to power the LDR Link units, please contact domo if these are required

If the unit is in standby press and hold down the RF button to power up the unit.

7.4.3 Control Connections

The 7 way Amphenol connection is used for control interfacing.

The control cable is used for Control, and is used to connect the LDR Link unit to a PC with a suitable RS232 control interface for connection to the domo PC GUI application or an embedded control application.

7.4.4 Video Output

Connect the video output to the Amphenol connector labeled 'Video Out'.

Connector	Signal
Video BNC (on cable)	75 ohm composite video source, PAL or NTSC software selectable

Typically the video monitor will be PAL or NTSC monitor.

7.4.5   Antennas

The unit is supplied with 868MHz (or 458MHz) omni-directional flexible antennas as standard. These should be screwed directly to the panel mount TNC RF IN connector. Care should be taken to not over tighten the antenna. It is recommended that the transmit antenna should be connected directly to the unit and not via a cable. Any cable in this position will reduce the range performance of the equipment.

Important Note: The supplied antennas are dipole antennas and do not require a ground plane. Users might wish to use other antennas, such as directional antennas for greater range.

Additional antennas may be ordered from domo. For longer range, more specialized antennas such as Yagis can be supplied.

7.4.6   Installation notes

The domo LDR Link receiver is supplied in a rugged chassis with mounting holes for ease of integration. It is designed for simple integration into any system.

The LDR Link receiver can be mounted in an outdoor situation. In an outdoor situation care should be taken to mount the unit with the connectors pointing downwards. The cable connectors must be protected by the drip ledge.

7.5   Powering on the System

All external connections to the LDR Link System should be made, as described in the previous sections, before proceeding to power on the system.

7.5.1   Applying power to the LDR Link Receiver

On powering the LDR Link receiver, one of the eight green configuration LEDs on the control panel will light (which one depends on which configuration was active when the receiver was switched off). The red Alarm LED may light if the receiver is unable to lock to a signal.

If none of the LEDs on the control panel light then the Receiver may be in standby mode. If this is the case then press, and hold the RF button for more than one second.

7.5.2 Applying power to the LDR Link Transmitter

When powering the LDR Link transmitter directly from a DC source, the following will be observed.

If none of the LEDs on the control panel light then the transmitter may be in standby mode. If this is the case then press, and hold the RF button for more than one second.

One of the eight green configuration LEDs on the control panel will light (which one depends on which configuration was active when the transmitter was switched off).

The alarm LED may be lit, typically if there is a serious error with the unit (video input lock alarm is not currently supported).

7.5.3 Switching on the RF

On the transmitter unit control panel, press the RF button briefly until the RF LED lights. This indicates that the RF output is active, and that the unit is transmitting.

If the receiver is able to receive the transmitted signal, the receiver RF LED will light indicating receiver lock, and the receiver ALARM LED should go out. The signal strength LEDs will indicate the received signal quality.

Data and audio signals will be presented automatically at the receiver outputs.

NOTE:

The signal quality may be degraded if the units are placed too close together and the signal is too strong. Move the units further apart.

7.5.4 Changing Configuration

domo LDR Link equipment features eight user selectable and programmable configurations. By default, all 8 configurations are available to the user. The configuration that is currently active is indicated by which of the eight configuration LEDs is lit on the control panel. Pressing the 'CONFIG button on the control panel of any domo LDR Link equipment will select the next configuration in order.

On the LDR Link transmitters, changing a configuration turns off the RF output to prevent accidental transmission and potential interference. The RF output must manually be re enabled once the user is confident that the correct configuration has been selected.

Modifying the default configurations is done from the PC control application, as described in the section on Advanced Operation.

7.5.5 Front Panel Lock

Pressing and holding down the CONFIG button for more than 1 second will toggle the front panel lock feature. This prevents accidental key presses on the panel affecting the unit's operation.

7.5.6 Standby

Any of the LDR Link transmitters and receivers can be placed in a low current consumption standby mode by pressing and holding the RF button for one second. The LEDs will go out indicating that the unit is in standby mode.

Pressing and holding the RF button for one second brings the unit back out of standby mode.

7.5.7 Achieving a Video Link

Once an RF connection has been successfully achieved, then a video link can be formed.

With a suitable camera source connected to the LDR Transmitter, video should be displayed on the monitor connected to the video output of the LDR Receiver.

The LDR system is a very low bitrate system and sends informational quality video. The LDR system can be optimized by users to send different video frame rates and resolutions.

Frame Rate Options: 2, 5 or 12 F/s

Resolution Options: CIF (352 * 288 pixels) or QCIF (176 * 144 pixels)

Typically domo recommends the following settings.

50KHz Bandwidth:	2 Frames/s CIF
75 and 100KHz Bandwidth:	5 Frames/s CIF
125KHz Bandwidth:	12 Frames/s CIF

8   Advanced Operation

8.6   Technical Overview

8.6.1   OFDM Transmission

The LDR Link transmitter and receiver utilise Orthogonal Frequency Division Multiplex for modulation. This modulation scheme provides excellent protection against multi-path and interference. The system employs interleaving and two levels of error correction (Low Density Parity Codes & BCH decoding) to further enhance performance.

The modulator channel width may be set in multiples of 25kHz. This determines spectrum bandwidth and the gross bit rate of the system in multiples of 14.7Kbits/s. The bandwidth of the modulated signal is roughly 4/5 of this channel spacing. The default mode is 75KHz.

A combination of IF and digital filtering provide receiver selectivity. The demodulator allows the user to read various parameters such as the input signal level, the signal to noise ratio and raw error rates via the remote control interface.

8.6.2   Video Compression

The LDR Link operates a sophisticated MPEG4 encoder operating at very low bitrates. The encoder is capable of operating in two resolutions 352 * 288 or 176*144, and at different frame rates 12, 5 or 2 frames per second. The unit is defaulted to 352 * 288 at 5 frames per second.

8.6.3   AES Encryption

The LDR Link module supports both AES128 and AES256 encryption. These provide a very secure method of handling data and audio. Both AES128 and AES256 are licensable features. To enable encryption a 32 digit hex key, (or in the case of AES256 two 32 digit hex keys) must be written to the unit. The scrambling mode must then be set to the appropriate mode of operation.

The AES128+ and AES256+ options in the receiver can be used to prevent the receiver accepting unscrambled streams which may be useful in some applications. Note that having mismatched keys between Tx and Rx may allow a small amount of encrypted data to pass through the data pipes.

AES128 and AES256 are licensable features and are only supported in certain countries.

8.1 SOLO4 System PC Controller Application Software

Advanced control of the SOLO4 system is available by using PC control applications.

Typically users may want to customize the default configurations to control settings such as frequency, scrambling keys, modulation parameters etc.

- Both the SOLO4 Telemetry Transmitter and Receiver are controlled with the same application telemetry_ctrl.exe which auto-detects the type of unit it is connected to.

Note that exact file names may change as software version information is a part of **domo** file names.

A PC is required with two RS232 Serial COM ports to control both a transmitter and receiver simultaneously. Where changes are to be made to either a transmitter, or a receiver, at different times, a PC with a single RS232 Serial COM part can be used.

Installation the two control programs is as simple as copying them from the CD to a suitable location on the PC. No install shield routine is launched. Note that the controllers generate their own log and initialisation files, so it is best to create a dedicated directory for these applications, perhaps with links to the applications from the desktop of the PC.

Use the supplied cables to connect the chosen COM port(s) of the PC to unit(s) to be configured.

Launch each application in turn by double clicking or using the run command.

Connection with a SOLO4 Telemetry product should be automatic, but the user can force selection of the correct COM port using the drop down, followed by the "Connect" button.

Errors such as the following may appear during the connection process if the PC is unable to automatically ascertain which unit is connected to which COM port.

- Error attempting to read invalid address

- Error has occurred during polling, polling has been disabled

Changes can be made to the unit configuration using the drop down and data entry fields.

Changes are only applied to the unit when the "Apply New Values" button is clicked.

Current values, as running in the unit, can be read using the "Refresh" button.

Parameters that are status information only appear in greyed in the application.

Further engineering and configuration controls can be found within the "Options" and "File" drop down menus in the application title bars.

8.2 LDR Link Transmitter Control Application

Important – version 1.3 and above of the telemetry controller should be employed with the LDRL transmitter.
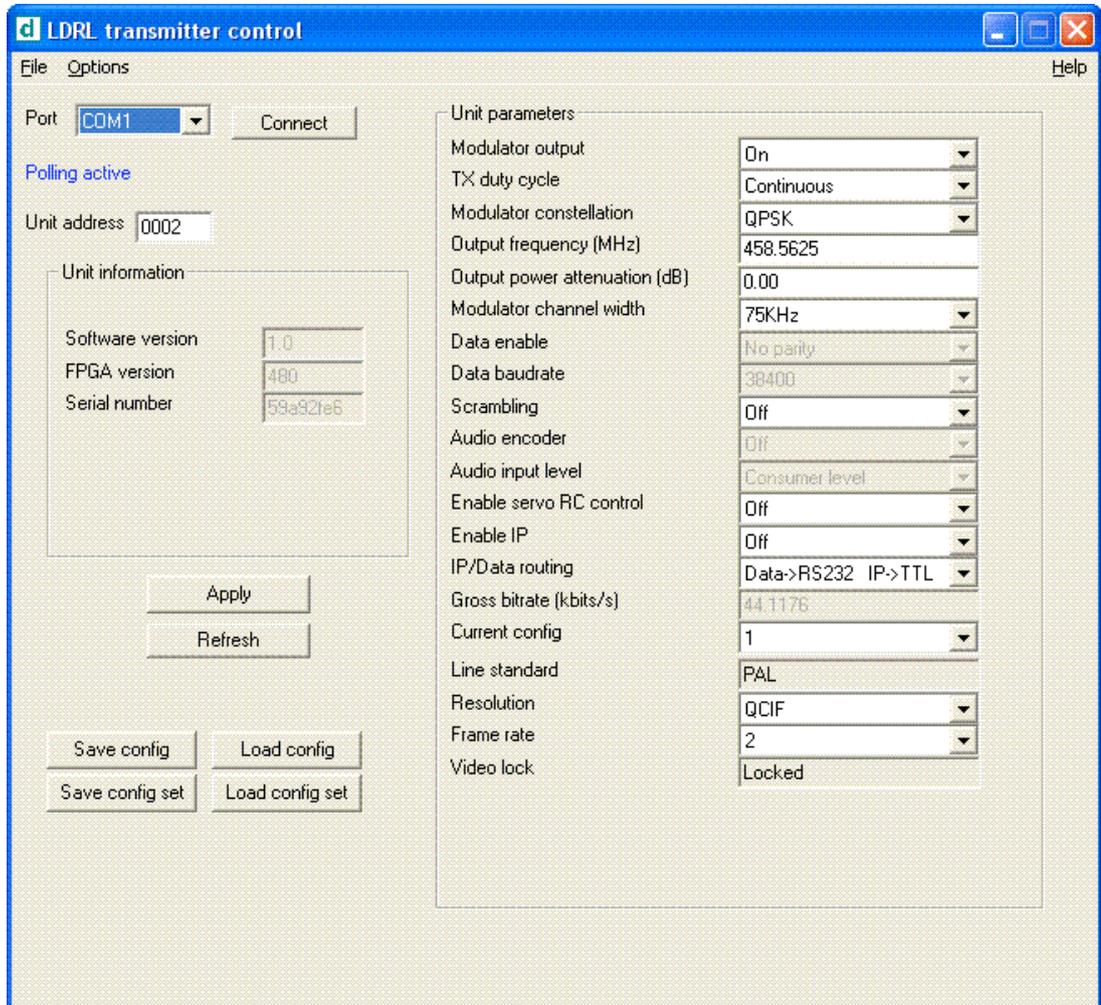
8.2.1 Modulation Output

This control is used to turn on and off the RF output. After a configuration change, the output always reverts to OFF.

8.2.2 TX Duty Cycle

This determines whether the transmitter operates in continuous or discontinuous mode.   Should be set to Continous

8.2.3 Modulator Constellation

The COFDM mode can be changed between QPSK and 16QAM. QPSK is the default mode and will give the strongest most rugged RF link performance. Selecting 16QAM reduces the link performance by 5.5dB but doubles the link data throughput.. Should be set to QPSK

8.2.4 Output Frequency (MHz)

The transmit frequency can be changed by entering the new desired frequency in this field. Values outside the range supported by a particular transmitter type will be rounded to the highest of lowest supported frequency as appropriate.

The transmit frequency can be set in step sizes of 12.5kHz. In License exempt mode of operation the frequency, bandwidth power level and TX duty cycle will be adjusted accordingly.

8.2.5 Output Power Attenuation

This sets the output attenuation in dB. 0dB corresponds to a nominal maximum level of 100mW.

8.2.6 Modulator Channel Width

Sets the modulator channel width in 25kHz steps. The width of the spectrum is about 4/5 of this channel width.   Should be set to 75KHz. Typically only 50, 75, 100 and 125KHz are supported.

8.2.7 Data Enable/Parity

With this control the user can select whether the transmitter passes serial RS232 data across the RF link to the receiver. A choice of no parity, even & odd parity is selectable.

8.2.8 Data Baud Rate

In LDRL mode this field is for information only.

Bandwidth 50KHz = Baudrate 19K2

Bandwidth 75KHz = Baudrate 38K4

Bandwidth 100KHz = Baudrate 38K4

Bandwidth 125KHz = Baudrate 56K6

8.2.9 Scrambling

If the AES scrambling option has been purchased for the SOLO4 Telemetry system in use, then it is possible to encrypt the link. Scrambling must be enabled at the transmitter by selecting either AES128 or AES 256 in the scrambling field. At this point the user will need to ensure that the correct key is in use and this is done by using **Options / Write AES Key**.

The key is a 128bit key for AES128 and a 256bit key for AES256 and is entered as either 32 or 64 ASCII hexadecimal characters (0..F).

8.2.10 Audio Encoder

The Audio can be enabled with this control. Audio is off by default, and there are 2 mono modes available to the user. 24Kbits/s toll quality and 32Kbits/s telephone quality may be selected both at 8KHz sampling rate. Some bit-rates will not support audio. Should be OFF

8.2.11 Audio Input Level

This control is used to define the audio gain to be applied to the audio input signal. 0dB is used for line level audio and various options up to 48dB of gain can be applied for microphone inputs.

8.2.12 Enable RC servo control

Enables the 2 channel joystick and servo interfaces. Not applicable to LDR Link.

8.2.13 IP Enable

Enables the IP interface for the Netstream unit. Not applicable to LDR Link.

8.2.14 IP/Data Routing

The IP/data routing can be set to allow the IP pipe to use the RS232 data input on the Telemetry unit (default is RS232 data pipe). Alternatively the IP data between the Netstream and the Telemetry unit can use the TTL interface. Not applicable to LDR Link.

8.2.15 Gross Bit Rate (Status Only)

This give an indication of the channel bit rate available. This can be useful in calculating data throughput.

8.2.16 Current Config

This field reports the last loaded configuration number. Note that for the SOLO transmitter, changes applied after the configuration has been loaded are saved immediately into the current configuration.

8.2.17 Line Standard

Auto-detected video line standard on the LDR Transmitter, PAL or NTSC.

8.2.18 Resolution and Frame Rate

The LDR system is a very low bitrate system and sends informational quality video. The LDR system can be optimized by users to send different video frame rates and resolutions.

Frame Rate Options: 2, 5 or 12 F/s

Resolution Options: CIF (352 * 288 pixels) or QCIF (176 * 144 pixels)

Typically domo recommends the following settings.

50KHz Bandwidth: 2 Frames/s CIF

23

75 and 100KHz Bandwidth:	5 Frames/s CIF
125KHz Bandwidth:	12 Frames/s CIF

8.2.19 Video Lock

Not currently supported

8.2.20 Unit Address

This is the unit address of the unit being controlled.

8.2.21 Software Version (Status Only)

This status information describes the version of the software running the SOLO4 transmitter product.

8.2.22 FPGA Version (Status Only)

This information is for domo engineering use only.

8.2.23 Serial Number (Status Only)

This status information is the electronic serial number of the transmitter PCB. This number can be exchanged with domo to purchase extra licensable features, such as upgrades to support AES encryption.

8.2.24 Options

Timeouts – access to change timeouts used during the serial communications between the unit and the controller.

Engineering – access to further diagnostic and calibration features.

Write License Code – open box for entering license codes for the activation of licensable features (e.g. AES scrambling) in the transmitter. Contact **domo** for support in applying new licenses as required.

Change RS232 address – prompts the user to change the units RS232 address, which can be useful when connecting multiple units together via a multi drop RS485 bus for control purposes.

Write AES Key – opens a dialogue box for entering a 128bit and 256bit AES scrambling key, as 32 ASCII hexadecimal characters (0…F)

Restore Defaults – restores factory default settings in the transmitter.

8.2.25 File

Change Logfile – opens a standard Windows file save dialogue box which allows the user to change the path and name of the log file generated by the application.

Exit – exits the SOLO4 receiver control application

8.3   LDR Link Receiver Control Application

Important – version 1.3 and above of the telemetry controller should be employed with the LDRL transmitter.
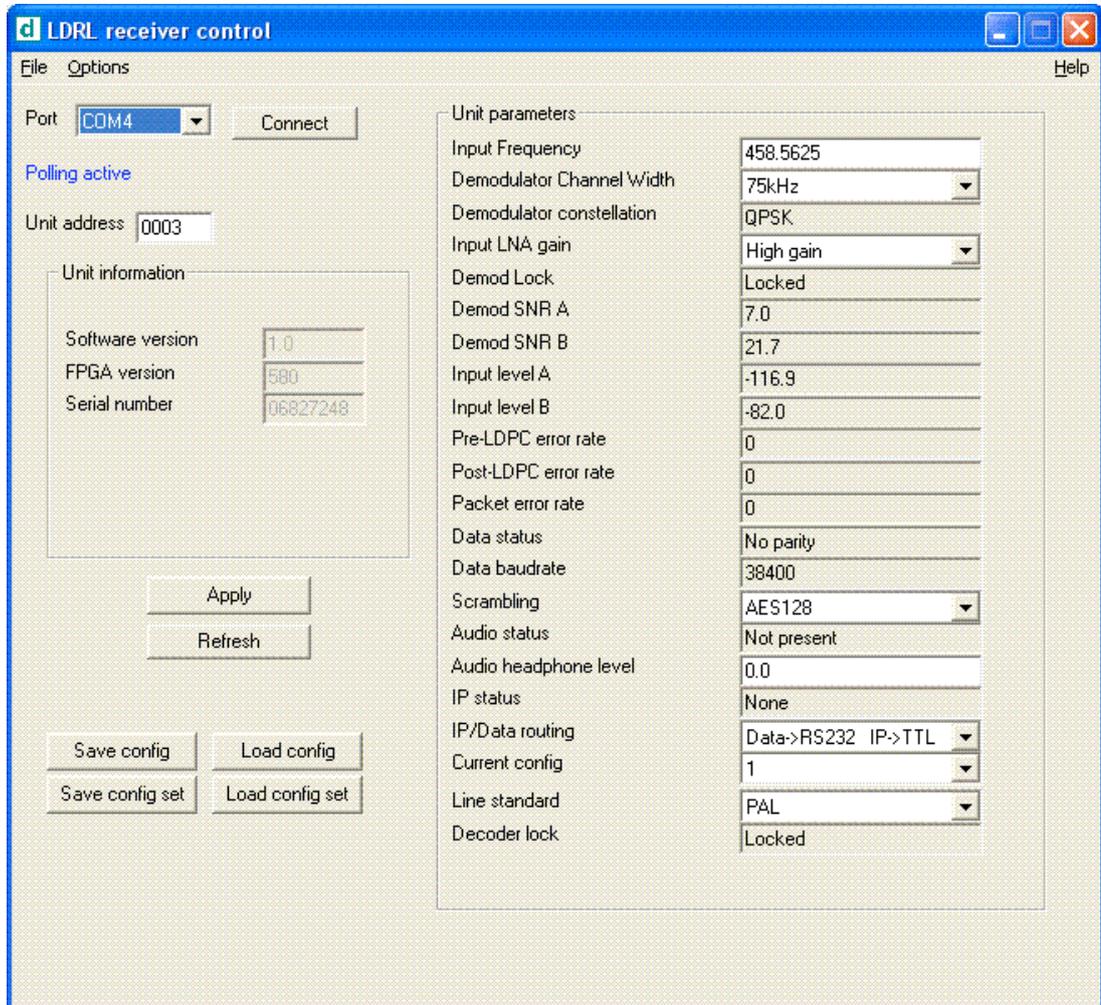
8.3.1   Input Frequency

The receive frequency can be changed by entering the new desired frequency in this field.

8.3.2   Demodulator Channel Width

Sets the demodulator channel width in 25KHz steps. This must match the modulator channel width. For LDRL 50, 75, 100 and 125KHz are applicable.

8.3.3   Demodulator Constellation (Status Only)

This field displays the COFDM constellation that is being demodulated at the receiver. In normal operation this will match that selected at the transmitter.

8.3.4 Input LNA gain

This allows selection of the input gain at the front end of the demodulator. Low gain mode improves the blocking on the input by about 10dB but has a similar reduction on sensitivity.

8.3.5 Demod Lock Status (Status Only)

This indicates whether the demodulators are successfully locked to the RF signal.

8.3.6 Input SNR (Status Only)

For each IF input, the SNR (Signal to Noise Ratio) is reported. Values in the order of 18dB to 22dB represent strong received signals, whilst values in the order of 5dB represent poor received signals which will likely give rise to decoding errors.

8.3.7 Input Level (Status Only)

This figure indicates the received signal level at the two receiver inputs. Normal Operation will occur when the input level is between –25 and –115 dBm. Signals greater than –25 may be too powerful and cause damage. Signal less than -115dBm may be too weak and cause data loss (typical link failure will occur between –118dBm depending on mode). The input level may also increase when the antennas are connected and there is no transmission. This indicates the presence of interference.

8.3.8 BER Pre-LDPC (Status Only)

This is the raw error rate prior to the error correction techniques having been applied in the receiver.

8.3.9 BER Post-LDPC (Status Only)

This is the error rate before the BCH decoder.

8.3.10 Packet Error Rate (Status Only)

This is a measure of the number of un-correctable errors in the system. Any value other than 0 with cause loss of data, break up of audio and is a good indication of link failure.

8.3.11 Data Status (Status Only)

This field shows the presence of data in the system by indicating the parity of the data or none if no data is present.

8.3.12 Data Baud Rate (Status Only)

This field reports the baud rate of the RS232 serial data component that is present and selected in the stream.

8.3.13 Scrambling

If the AES scrambling option has been purchased for the SOLO4 system in use, then it is possible to encrypt the link. Descrambling must also be enabled at the receiver by selecting AES128 or AES256 in the descrambling field. At

this point the user will need to ensure that the correct key is in use at the receiver and this is done by selecting **Options / Write AES Key** in the receiver controller.

The key is a 128bit value for AES128 and a 256bit value for AES256, and is entered as 32 or 64 ASCII hexadecimal characters (0...F).

The AES128+ and AES256+ modes prevent clear streams from passing through the system which can be useful in certain applications.

8.3.14 Audio Status (Status Only)

This field shows the presence of audio in the system. Not applicable to LDRL.

8.3.15 Audio Headphone Level

This allows the user to adjust the audio output level in the receiver. The nominal level is set to 0dB. Not applicable to LDRL.

8.3.16 IP status

This field indicates the presence of IP data on the link. Not applicable to LDRL.

8.3.17 Data Routing

The IP/data routing can be set to allow the IP pipe to use the RS232 data input on the Telemetry unit (default is RS232 data pipe). Alternatively the IP data between the Netstream and the Telemetry unit can use the TTL interface.

8.3.18 Current Config

This field reports the last loaded configuration number. Note that for the SOLO transmitter, changes applied after the configuration has been loaded are saved immediately into the current configuration.

8.3.19 Line Standard

The LDRL decoder does not auto detect line standard, therefore this needs to be set to reflect the input camera line standard, either PAL or NTSC.

8.3.20 Decoder Lock

This information field indicates the status of the MPEG4 decoder, it should be locked for normal operation.

8.3.21 Unit Address

This is the unit address of the unit being controlled.

8.3.22 Software Version (Status Only)

This status information describes the version of the software running the SOLO4 transmitter product.

8.3.23 FPGA Version (Status Only)

This information is for domo engineering use only.

8.3.24 Serial Number (Status Only)

This status information is the electronic serial number of the transmitter PCB. This number can be exchanged with **domo** to purchase extra licensable features, such as upgrades to support AES encryption.

8.3.25 Options

Timeouts – access to change timeouts used during the serial communications between the unit and the controller.

Engineering – access to further diagnostic and calibration features.

Write License Code – open box for entering license codes for the activation of licensable features (e.g. AES scrambling) in the transmitter. Contact **domo** for support in applying new licenses as required.

Change RS232 address – prompts the user to change the units RS232 address, which can be useful when connecting multiple units together via a multi drop RS485 bus for control purposes.

Write AES Key – opens a dialogue box for entering a 128bit and 256bit AES scrambling key, as 32 ASCII hexadecimal characters (0…F)

Restore Defaults – restores factory default settings in the transmitter.

Polling Enabled – selecting this option makes the control application automatically refresh the data presented to the user every few seconds.

8.3.26 File

Change Logfile – opens a standard Windows file save dialogue box which allows the user to change the path and name of the log file generated by the application.

Exit – exits the SOLO4 receiver control application

9   Fault Finding

9.4   Fault Symptoms

Symptom	Suggested Action
No RF Link	Check a suitable transmitter RF transmitter is active, both units on correct frequency, and correct bandwidth settings with antennas connected. Ensure there is no interfering signal.
Poor link performance	Poor performance of the link can occur for the following reasons. • Interference. Should an interfering RF signal occur on the same frequency the performance of the link will be affected. Remove the interferer e or move to an alternative frequency. • Unsuitable antennas, or out of band antennas. See the antenna sections for guidance on antenna selection and use. • Reduced transmit power, ensure that the attenuation setting on the transmitter is appropriate. • Receive antenna positioning, were possible mount the receive antennas away from other objects, unobstructed and away from any electronics likely to generate interference. • No Diversity operation. Ensure both antennas are operational.
Loss of data	Check link performance, data cables are in good condition and correct use of Xon/Xoff flow control. In discontinuous mode check 'Ton' period is not too short.
No Video	Check RF Link is functioning (see above) Check video input is connected Check cable from LDR Link Receiver to PC is connected and is 'Data Cable' Check correct 'Comm port' is selected on StreamView software
No Decoder Lock displayed at Receiver	Indicates that the LDRL receiver can not see a valid stream from the LDRL transmitter. Check that RF lock has been achieved (see above) Check that the camera is connected.
Unstable Video	Check the LDRL decoder line standard matches the camera (PAL / NTSC)

10 LED Indicators

10.5 LDR Link TX

LED Condition	Meaning
Red ALARM LED lit permanently	Unit is faulty / incorrect software loaded
RF LED blinking	Unit in discontinuous mode, RF inactive, RF must be continuous for LDRL.
RF LED lit	RF output active
RF LED not lit	RF output inactive
Single CONFIG LED lit	Indicates selected config
Front Panel Lock	Indicates front panel locked
RF Bar Graph	RF output level
No LEDs lit	Unit in standby or Off

10.6 LDR Link RX

LED Condition	Meaning
Red ALARM LED lit permanently	Unit is faulty / incorrect software loaded
RF LED off	No RF signal lock
RF LED on	RF signal lock
Single CONFIG LED lit	Indicates selected config
Front Panel Lock	Indicates front panel locked
RF Bar Graph	RF signal quality
No LEDs lit	Unit in standby or Off

11 Technical Specifications

11.7 Bandwidths and Bitrates

Channel Spacing	Channel Bandwidth	User Bitrate (QPSK)
25 kHz	20 kHz	Not Supported
50 kHz	40 kHz	29 kbits/s (19K2 baud of video)
75 kHz (default)	60 kHz	44 kbits/s (default) (38K4 baud of video)
100 kHz	80 kHz	58 kbits/s (38K4 baud of video)
125 kHz	100 kHz	73 kbits/s (56K6 baud of video)
150 kHz	120 kHz	Not Supported
175 kHz	140 kHz	Not Supported
200 kHz	160 kHz	Not Supported
225 kHz	180 kHz	Not Supported
250 kHz	200 kHz	Not Supported
275 kHz	220 kHz	Not Supported
300 kHz	240 kHz	Not Supported

11.8 SOLO4 Telemetry Transmitter

Operating Frequency	**458MHz or 868-870MHz (ISM)**
Modulation	Default QPSK 1/16 Guard 105 carrier OFDM QPSK/16QAM 1/16 guard
Channel Spacing	Default 75KHz 25,50,75,100,125..300KHz
Channel Bandwidth	20,40,60,80,100..240KHz
Maximum output power	100mW
Power Supply Voltage	5.5-18V
Power dissipation	<3W
RS232 data rates	1200,2400,4800,9600,19200,38400,57600,115200
RS232 parity	None, Even, Odd with Xon/Xoff flow control where necessary
Video	Default 5 frames per second, 30kb/s, 352*288

	Frame Rate 12 or 5 or 2 frames/s Resolution 352* 288 or 176*144

11.9 LDR Link Telemetry Receiver

Operating Frequency	**458MHz or 868-870MHz (ISM)**
Modulation	Default QPSK 105 carrier OFDM QPSK/16QAM 1/16 guard
Channel Spacing	Default 75KHz 25,50,75,100,125KHz, (and 150,175,200,225,250,275,300KHz with wider IF filter)
Antenna	2 way diversity MRC
Input sensitivity	< -113dBm@100KHz 16QAM, -118dBm@100KHz QPSK, -121dBm@50KHz,
Image rejection	> 52dB (10.7MHz IF Hi-Side LO)
Adjacent channel rejection	> 45dB
Error correction/detection	2112 bit rate ½ soft LDPC, 968/1056 BCH
Power Supply Voltage	5.5-18V
Power dissipation	<3W
RS232 data rates	Default 38k4 1200,2400,4800,9600,19200,38400,57600,115200
RS232 parity	None, Even, Odd

12 Connector Pin Outs

12.10 LDR TX and RX - Power Amphenol

Amphenol - 3 way pin part no.62GB-57A08-33PN

Pin A: 12V
Pin B: GND
Pin C: unused

12.11 LDR TX and RX - Control Amphenol

Amphenol - 7 way socket part no.62GB-57A10-07SN

Pin A: Unused
Pin B: RS232 data In
Pin C: unused
Pin D: Unused
Pin E: RS232 data Out
Pin F: GND
Pin G: Unused

12.12 LDR TX and RX – Video Amphenol

Amphenol - 4 way socket part no.62GB-57A08-04SN

Pin A: Power (voltage out)
Pin B: GND
Pin C: Video GND (screen)
Pin D: Video Input (transmitter) Video Output (receiver)

13 Control Protocols

The following section describes the control protocol employed on the RS232 link for controlling the LDR Link transmitters and receiver equipment.

Connection details are detailed in previous sections.

Note that only features that are licensed for use in the LDR Link units can be controlled. The protocols listed here cover all possible features. Attempting to activate an unlicensed feature will simply result in the command being ignored by the LDR Link unit.

TX commands sent to an RX unit and visa-versa will be acknowledged have no effect.

13.13 RS232 Control – General Principles

The physical interface is RS232 but this can be converted to RS 485 with an external adapter where multiple units are controlled over one RS 485 bus.

Normal operation involves sending a packet from the control device (normally a PC) to the device being controlled. If the packet satisfies an address integrity check, then the controlled device will action the command and send a reply.

For compatibility with modems an ASCII style protocol is used.

Ports are set for 9600 Baud, 8 bits, No parity, 1 stop

13.14 Packet Structure Sending (from PC)

ASCII	Value	
STX	02h	Start byte
0-9	30h-39h	4 byte unit address. In range 0-9999
R misc	20h-7Eh	1 byte command type. **r** read, **w** write or **m**
I	20h-7E	1 byte indicator of internal data block
ABC	20h-7Eh	Command –three byte mnemonic
;	3Bh	Separator
PQR	20h-7Eh	Data –Optional, variable length
;	3Bh	Separator
X	20h-7Eh	Sum Check
ETX	03h	End byte

13.15 Packet Structure Reply (from controlled device)

ASCII	Value	
STX	02h	Start byte
0-9	30h-39h	4 byte unit address. In range 0-9999
Z	20h-7Eh	Status BYTE
PQR	20h-7Eh	Data –Optional, variable length
;	3Bh	Separator
X	20h-7Eh	Sum Check
ETX	03h	End byte

The Sum check byte is the summation of all bytes in the packet, not including the start and end bytes. Higher order bytes are ignored and the final byte result is modified to prevent ASCII control characters being sent. Bit 7 (highest) is forced high.

Status byte will indicate command performed OK, or indicate an error.

ASCII	Meaning
1	All OK
E	General error, Command could not be actioned

Typically E will be returned if the message is formatted incorrectly (separators in wrong place) or if commands are in upper case, or if commands do not match against the allowed list of commands, or if the checksum is wrong.

Addresses in the range 0001 to 9998 are for general use. Address 0000 is reserved and 9999 is a broadcast address. i.e. any device will reply to this address. Its reply will contain its own specific address.

All data in the transmitter and receiver is stored as one of 5 data types, Double, String, List, Integer or HexInteger. The data type dictates the contents of the data section of the reply.

- List – 1 byte for sending. Value is hexadecimal coded as ASCII. 2 byte reply. Reply represents index into original choice list. e.g. Reply 02 indicates entry 2 in original list.

- Double - variable length. Reply always contains decimal point and 4 decimal places. Can have 1 to 3 digits before decimal.

- Integer - 6byte reply. integer value with stuffed with preceding zeros. e.g. GOP reply 000012 = GOP length 12

- String - Variable length. Reply is string excluding null terminator

- HexInteger – 8byte Hex reply

13.16 Telemetry System Command List

Comm	Description	Tx/Rx	RW	Type	Comments	Default
gadd	Unit address	TxRx	RW	Integer	9999 - broadcast address	2-tx,3-rx
gser	Unit serial number	TxRx	R	Hex		
gver	Software version number	TxRx	R	String		
gfpg	FPGA version number	TxRx	R	Hex		
gdef	Restore defaults	TxRx	W	Integer	1 - restore defaults	
glic	License code	TxRx	W	Hex		
gsle	Sleep	TxRx	RW	Integer	0 - active, 1 - sleep mode	0
glod	Config number	TxRx	RW	Integer	1-8 config	1
gtyp	Unit Type	TxRx	R	Integer	bit0=0 Tx, bit 0=1 Rx	
gau2	Set remote command	Tx	RW	Integer	1 - allow remote commands, 0 = off	0
gfpl	Front panel lock	TxRx	RW	Integer	0 - unlocked, 1 = locked	0
gstt	Enable status display	Rx	RW	Integer	0 - disabled, 1 - enabled @ 9600 baud	0
oout	Modulator output	Tx	RW	Integer	0 - Off, 1 - On	0
omod	Modulator constellation	Tx	RW	Integer	0 - QPSK, 1 - 16QAM	0
odut	TX duty cycle	Tx	RW	Integer	0 - Continuous, 1 - Discontinuous operation	0*
ofre	Output frequency	Tx	RW	Float	MHz	869.45*
opwr	Output power attenuation	Tx	RW	Float	dB	0*
onrt	Modulator Channel Width	Tx	RW	Integer	1 - 25KHz ... 5 - 125KHz	4*
omux	Gross TX bit rate	Tx	R	Float	Kbits/s	
cflo	Minimum operating frequency	TxRx	RW	Float	MHz	868
cfhi	Maximum operating frequency	TxRx	RW	Float	MHz	870
cplv	Power level calibration level	Tx	RW	Float	dB	
cton	TX on timeout	Tx	RW	Integer	Timeout before data is sent in discontinuous mode	8
ctof	TX off timeout	Tx	RW	Integer	Timeout before Tx turns off in discontinuous mode	8
dpid	Tx Data PID	Tx	RW	Integer	0x10-0x17	0x10
dinp	Tx Data Enable	Tx	RW	Integer	0 - off, 1 - no parity, 2 - even parity, 3 - odd parity	1
dbau	Tx Data Baudrate	Tx	RW	Integer	0 - 1200,2400,4800,9600,19200,38400,57600,115200	6
drem	Tx Aux Control PID	Tx	RW	Integer	0x28-0x2f	0x28
1fre	Input Frequency	Rx	RW	Float	MHz	869.45*
1nrt	Demodulator Channel Width	Rx	RW	Integer	1 - 25KHz … 5 - 125 KHz	4*
1lna	Input LNA gain	Rx	RW	Integer	0 - high gain, 1 - low gain	0
1loc	Demod Lock	Rx	R	Integer	0 - No, 1 – Yes	
1snr	Demod SNR A	Rx	R	Float	dB	
1mer	Demod SNR B	Rx	R	Float	dB	
1ina	Input level A	Rx	R	Float	dB	
1inb	Input level B	Rx	R	Float	dB	
1pre	Pre-LDPC error rate	Rx	R	Integer		
1pos	Post-LDPC error rate	Rx	R	Integer		
1pkt	Packet error rate	Rx	R	Integer	0 is good	
1mod	Demodulator constellation	Rx	R	Integer	0 - QPSK, 1 - 16QAM	
fpid	Rx Data PID	Rx	RW	Integer	0x10-0x17	0x10
finp	Rx Data Status	Rx	R	Integer	0 - None, 1 - no parity, 2 - even parity, 3 – odd parity	
fbau	Rx Data Baudrate	Rx	R	Integer	0 1200,2400,4800,9600,19200,384,57600,115200	
frem	Rx Aux Control PID	Rx	RW	Integer	0x28-0x2f	0x28
zscr	Scrambling mode	TxRx	RW	Integer	0-Off, 4-AES128, 5-AES128+,6-AES256, 7-AES256+	0
zkez	128AES (256AES lower) key	TxRx	W	Hex	32 digit hex key	
zkex	256AES upper key	TxRx	W	Hex	32 digit hex key	

apid	Tx Audio PID	Tx	RW	Integer	0x40-0x47	0x40
aenc	Audio encoding mode	Tx	RW	Integer	0 - Off, 9 - g726 24Kbits/s, 10 - g726 32Kbits/s	0
alev	Audio input level	Tx	RW	Integer	0 - Consumer level, 1..4 - 12,24,36,48dB gain mic level	0
athr	Audio threshold level	Tx	RW	Integer	Audio level which triggers TX on in discontinuous mode	255
rpid	Rx Audio PID	Rx	RW	Integer	0x40-0x47	0x40
raud	Audio status	Rx	R	Integer	0 - Not present, 1 - Present	
rvol	Audio headphone level	Rx	RW	Integer	52 = -102dB, 255 = -.5dB, 0 = 0dB, 24 = +12dB	0
ppid	Tx RC PID	Tx	RW	Integer	0x58-0x5f	0x58
ppen	Enable Tx RC control	Tx	RW	Integer	0 - off, 1 - 2 channel RC	0
qpid	Rx RC PID	Rx	RW	Integer	0x58-0x5f	0x58
ipid	Tx IP PID	Tx	RW	Integer	0x30-0x37	0x30
ipen	Enable Tx IP	Tx	RW	Integer	0 - off, 1 - on (115200 baud), 2 - on (230400 baud)	0
jpid	Rx IP PID	Rx	RW	Integer	0x30-0x37	0x30
jinp	Rx IP Status	Rx	R	Integer	0 - None, 1 - on (115200 baud), 2 - on (230400 baud)	
irou	IP/Data Routing	TxRx	RW	Integer	0 - Data RS232, IP TTL or 1 - Data TTL, IP RS232	0

* Depends on unit type and license exempt operation

13.17 LDR Link Encoder/Decoder commands

Specific commands for the Low Data Rate Encoder/Decoder are sent on address 0009 using the same control protocol. The following commands are available:

Comm	Description	Enc/Dec	RW	Type	Comments
ebau	Encoder baud rate	Enc	RW	Integer	1 = 19200 baud 2 = 38400 baud 3 = 57600 baud 4 = 115200 baud
esta	Encoder line standard	Enc	R	Integer	1 = PAL 2 = NTSC
eres	Encoder resolution	Enc	RW	Integer	1 = CIF 2 = QCIF
efra	Encoder frame rate	Enc	RW	Integer	1 = 2 frames/s 2 = 5 frames/s 3 = 12 frames/s
eloc	Encoder video lock	Enc	R	Integer	0 = not locked 1 = locked
dbau	Decoder baud rate	Dec	RW	Integer	1 = 19200 baud 2 = 38400 baud 3 = 57600 baud 4 = 115200 baud
dser	Decoder service lock	Dec	R	Integer	0 = not locked 1 = locked
dsta	Decoder line standard	Dec	RW	Integer	1 = PAL 2 = NTSC

14 Typical Ranges of the LDR Link Product

Users of the LDR link product can expect operation over the following ranges.

Line Of Sight

Where a line of sight is available between the transmitter and receiver is available, then ranges of typically 20-40km are possible, ranges of this type require true line of sight.

Non Line of Sight Operation

Where there is no line of sight then users should expect a reduced range. Typically 800m to 1km is achievable with no line of sight. The trial below was performed in an urban environment and gives a reasonable indication of achievable range in an urban environment. In the trial below, both the transmitter and receiver where positioned at ground level.

Problem Solving a System Exhibiting Lack of Range

If the system is not delivering ranges as described above then the user should check the following potential issues.

- Have the antennas been installed on a ground plane.

- Is the selected channel free of interference (can be checked by using the PC control software connected to the telemetry receiver - see telemetry receiver handbook, advanced operation section) . The received power field of the telemetry receiver should show close to -120dBm when the transmitter is off, this indicates the channel is free of interference.