P372 Licence Plate Recognition Camera User Manual

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Document Revision History

Revision	Date	Comments
1st Draft	1 March 2004	Initial release
2nd Draft	27 March 2004	2nd Draft
2.0	10 January 2005	Formal Issue of version
2.1	26 January 2005	Rear connector information re-written More information about trigger and relay connections Tables of commands reformatted Camera mounting details added
2.2	16 August 2005	Application RS-232 port connections on rear panel detailed

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Contents

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1. Introduction

This user manual will provide the reader with sufficient information to set up and operate the P372 Licence Plate Recognition Camera safely and to carry out any routine maintenance tasks that may be necessary.

NOTE. This manual is to be read and clearly understood before operating the equipment.

1.1. Layout of the manual

The manual is organised into chapters as follows:

Section 1

This section is an introduction to the P372 Licence Plate Recognition Camera and gives an outline description of the contents of the manual.

Section 2

This section deals with the preparation of the system for use, describes the controls and interfaces to the P372. Example notes on software installation are provided.

Section 3

This section describes the maintenance tasks required to ensure continued successful operation of the P372.

Section 4

This section is a troubleshooting guide that helps in the diagnosis of the most common problems and, in most cases, suggests the appropriate course of action.

The appendices provide information on the configuration of the P372 with examples of customer applications.

2. Equipment Overview

The P372 is a single or dual camera complete with video processing/ control/ Automatic Licence Plate Reader (ALPR). The P372 is enclosed in a rugged extruded aluminium housing sealed to IP67.

The P372 can be supplied with CCIR (50Hz) or EIA (60Hz) camera(s).

The P372 offers the following functions:

- Integral monochrome camera module, with lens and optical band-pass filter.
- Integral colour camera module (optional).
- Integral infrared (IR) pulsed light emitting diode (LED) illuminator that compensates for sunlight and vehicle headlights.
- Camera control. The P372 controls its camera(s). The settings for the camera(s) can be changed on a field-by-field basis to implement the PIPS Technology patented triple flash exposure control.
- Plate Detection. The P372 detects the retro reflective return from a licence plate in hardware using digital signal processing (DSP) algorithms and captures the field containing the best image of the licence plate.
- Plate Recognition. The P372 streams the captured image to the software ALPR engine that performs OCR on the image and reports the VRN with an associated confidence of the result.
- Trigger. The P372 generates an internal trigger, from the DSP algorithm, to capture the image or an external trigger may be supplied to capture the image.
- Colour Overview. The P372 can be fitted with a colour overview camera to provide an overview image associated with the captured VRN image.
- Control. The P372 can be controlled from a PC or network using RS232 or Ethernet links.
- Modem. The P372 can be controlled from a modem allowing the P372 to work at remote sites and report the data over a GPRS modem link.
- Hot list. The P372 can check, in real time, the detected VRN against a white or black list of VRNs. Alarms can be raised when a match is found. New hot lists can be downloaded to the P372.
- Image handling. The P372 can store the images as BMP or compressed JPEG files to local memory or they can be transmitted over the Ethernet link to a server. Groups of images, VRN and overview can be grouped together and associated as one record. This group can be watermarked and hashed to ensure the integrity of the data.
- Upgrades. The P372 can receive software upgrades over the Ethernet link and store the file in flash memory.
- File system. The P372 has a battery backed SRAM file system used to store the event and analysis logs. All files are date and time stamped from the internal clock. The internal clock can be synchronised to an external time server.

2.1. Siting the P372

The P372 can be sited on poles, gantries or any elevated position giving a clear view of the road or carriageway to be monitored.

2.2. Rear connection panel

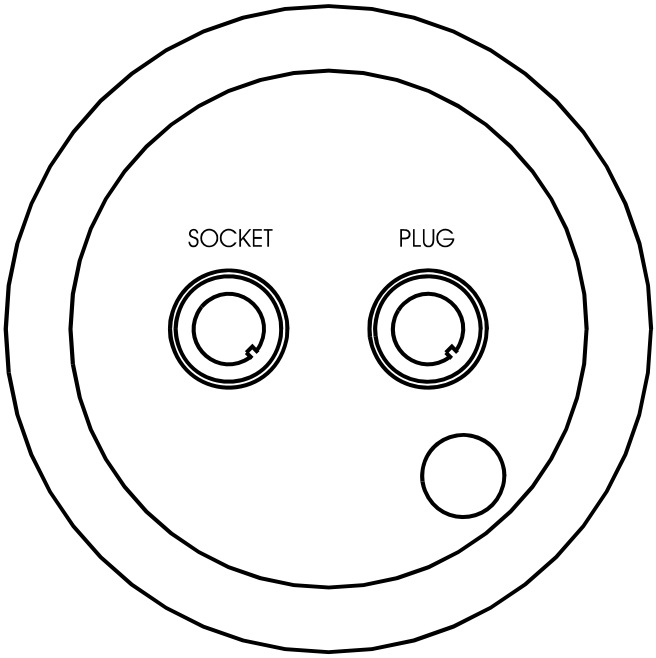

Figure 1 P372 Rear Connections

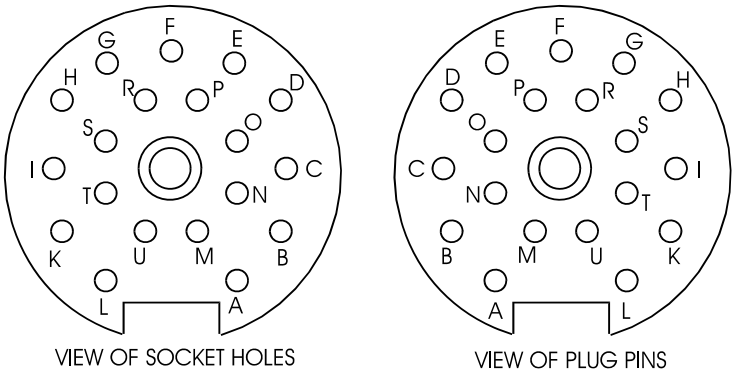

Figure 2 P372 Rear Connections - Detail

Details of the Connector 'Pin-Outs' are included in Appendix 2.

2.3. Installation

The P372 can be supplied with a break-out box for easy evaluation. This box provides Ethernet, video and serial connectors and the trigger and relay connections are also available at the serial connector. It also provides easy connection of the PSU unit.

For permanent installations information is provided in Appendix 2 for the cable configuration.

If required, connect the video monitor output(s) from the P372 to a suitable video monitor(s) using standard 75 Ohm video coaxial cable. Ensure that the video cable is terminated in 75 Ohms once (only) including all units through which the video signal may be looped.

Connection to the host system may be made via serial, Ethernet or modem connection as required by the OEM application.

If computer control of the settings is to be used then the unit may be connected to the computer by means of a standard serial port cable (NB not a NULL MODEM type).

The camera has an upper voltage limit of 18V. The terminal voltage at the camera must not drop below 12V otherwise the camera will reset. This restriction provides a limit to the maximum length of standard cable.

The standard cable is Belden type 9903. This has a "power pair" (red and black) which is equivalent to 24AWG. If an 18V power supply is used, then the maximum length of cable is limited 60 feet (18 metres).

At the bottom of the camera is fitted a mounting plate which slides in a slot in the extrusion. There are three tapped holes. The outer two are tapped M6 whilst the middle hole is tapped 1/4 - 20 UNC, which is the standard 1/4 inch tripod thread.

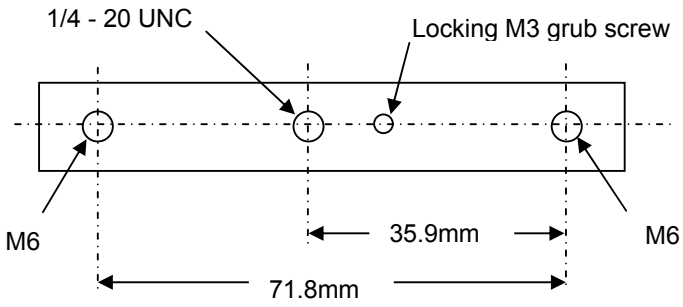

Fig 3. Mounting Plate

This plate can be slid along the housing slot by loosening the locking grub screw.

2.4. Computer configuration of the P372

This section describes the process required to prepare the software for a complete P372 demonstration system. Not all operations or procedures described here may be required in every demonstration or evaluation situation. The assumption is that the P372 will be connected to a single host PC.

2.4.1. Communications Link

In its current development and demonstration incarnation the P372 requires two communications links. These are the debug serial port and a TCP/IP connection to an ftp server for software loading and optional application software.

In this document, it is assumed that the TCP/IP connection is to a host PC running MS WINDOWS™ 2000™ service pack 4.

The PC must have TCP/IP protocol and FTP server installed. The detailed mechanism for doing this is beyond the scope of this document.

2.4.2. IP Addressing

The P372 must be issued with an IP (Internet protocol) address in order to communicate with management and application software. Also, the P372 needs to know the address of

its host PC server for software loading. An IP address is usually seen as a group of four numbers separated by dots. e.g. 100.100.100.100.

The IP addresses used need to match the rest of the network system in which the P372 is installed. The local network administrator will usually be responsible for issue of IP addresses.

For the purposes of this document assume that the PC is allocated 10.10.10.254 and the P372 is allocated 10.10.10.100.

2.4.3. PC Support Software

This section covers the PC software required to load and manage a demonstration or evaluation P372 system.

Confirm the IP address of the PC:

START | CONTROL PANEL | SETTINGS | NETWORK | PROTOCOLS | TCPIP | PROPERTIES

2.4.4. FTP Server

If it is not already in place:

Add the FTP server:

START | CONTROL PANEL | SETTINGS | NETWORK | SERVICES | ADD | MICROSOFT PEER WEB SERVICES

Configure the web server:

START | PROGRAMS | MICROSOFT PEER WEB SERVICES | INTERNET SERVICE MANAGER

Select FTP. Uncheck “Allow only anonymous connections”

Select directories. Add the desired directory. Typically d:\inetpub\ftproot

Add the FTP account.

Username: ftp_boot

Password: ftp_boot

Allow guest permissions with access only to the FTP directory set above

2.4.5. Keaterm

A telnet compatible terminal emulation program is required to interact with the P372 Command Line Interpreter (CLI). Hyperterm or telnet as supplied by Microsoft may be used. However these are of limited functionality. PIPS Technology recommend and use Attachemate KEA420 – KeaTerm. There are other flexible packages available which would also be very suitable.

Install Keaterm, following the installation guidelines. Novell support is not required. Create a short cut to Keavt.exe and drag this onto the desktop. Copy the KEA debug configuration file into place:

copy cd:\372debug.ktc ..\kea\user

Edit the short cut:

..keavt.exe ..\kea\user\372debug.ktc

Connect the 372 to the PC via the supplied debug serial lead. By default connect to COM1.

2.5. Set up tools

2.6. Aligning number plates

To aid the alignment of the P372 can export the image captured to a viewfinder application. Double click on the PIPS Viewfinder application on the desk top and the following screen appears.

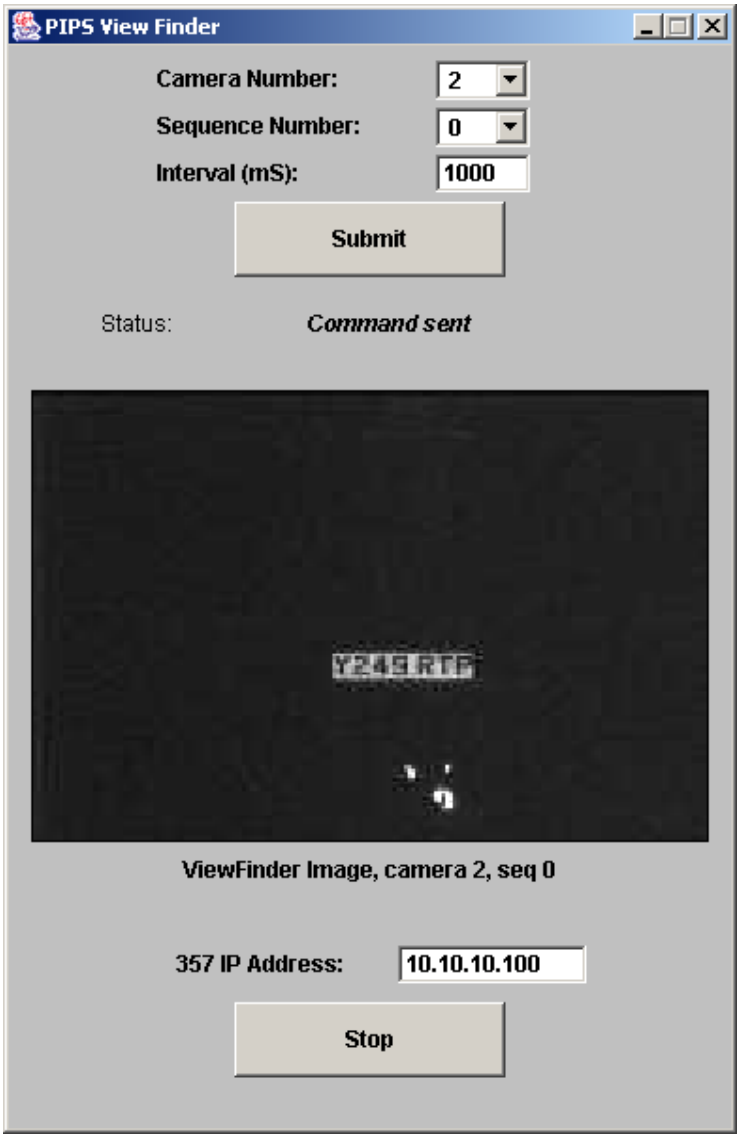

Figure 2 PIPS Viewfinder application

Confirm that the P372 is detecting a plate. Enter the IP address of the P372 and select the Run button.

The camera can be adjusted to align the plate in the image box in the viewfinder window.

This tool makes the alignment of the P372 camera possible when the P372 is looking at moving traffic. Using a monitor would result in only a few fields of images moving down the screen. The viewfinder application captures and holds the image until it is overwritten by the next image. This allows fine alignment adjustments of the of the P372 camera to be made.

3. Maintenance

The P372 operates with a power supply unit outputting a voltage between 12 and 18 volts. There are no user serviceable parts within the P372.

Routine maintenance of the P372 is limited to cleaning the unit and ensuring that the unit is properly secured and aligned.

4. Fault Finding

If the fault persists after following the procedures described in the table below, contact PIPS Technology for advice.

No	Fault	Possible Cause	Check/Solution
1	No Video	Cable damage or failure	Check all cables and power supply. Replace/repair damaged cable. Restore power supply.
2	Poor Retro-Reflection from Number Plate	Poor camera module alignment	Adjust/align using static number plate.
		Camera focus incorrectly set	Test using static number plate. If focus is poor, contact PIPS Technology for advice.
		IR illuminator failure	View with a Camcorder. If illumination is not present, contact PIPS Technology for advice.
		Dirt on camera	Clean the front window
		Camera window covered with protective film	Remove protective film.
3	Complete System Failure	Power supply failure	Check integrity of supply and rectify as required.

Table 1 P372 Fault Finding Guide

Appendix 1 Mechanical and Electrical Specification for the P372

1.1 Mechanical

Overall Dimensions		210 mm long, 107mm diameter excluding hood
Overall Weight		1.5kg
Casing Material		Aluminium, black anodised

1.2 Electronic

Operating Voltage		11.5 to 18 volts (at the camera connector)
Power Requirements	Maximum	20 watts
	Doze, LEDs off	14 watts
	Doze, LEDs off, Camera off	6 watts

1.3 Environmental Specification

Temperature (Storage)	-50, +50C
Temperature (Working)	-20, +50C
Sealing	To IP67
Vibration	(General Transport Specification) Mil Std-810D Method 514
Shock	BS-EN 60068 2-27

1.4 Statutory and Regulatory Considerations

EMC FCC Part 15, Subpart B, Class B (Digital Devices)	EN50081-1, EN50082-2
CE Low Voltage Directive	
Transport environmental specification TR1034	

Appendix 2 Connector pin outs

A2.1. Rear Panel Socket

Mating Cable Connector - Straight cable entry PIPS part number J34423C08ST19P

Right Angle cable entry PIPS part number J34423C0819P

Mating Cable with connector A350/34 (unterminated at other end)

Contact No	*Connection*	**A350/34 Cable** *Cable wire colour*
A	Ethernet XR-	Orange
B	Ethernet XR+	Yellow
C	Ethernet Screen	Drain wire of individual screens
D	Ethernet XT-	Green
E	Ethernet XT+	Blue
F	Camera 1	
G	Camera Screen	Grey
H	Camera 2	White
I	Battery Negative	Black
K	Battery Positive	Red
L	Screen	Overall screen drain wire
M	0 Volts	
N	Reserved	
O	Reserved	
P	Reserved	
R	Application Port RS-232 In (To P372)	
S	Application Port RS-232 Out (From P372)	
T	Reserved	
U	External LED Drive	

Table A.2.2(A). P372 Connector - Rear Connector with Socket Contacts

A2.2. Rear Panel Plug

Mating Cable Connector - Straight cable entry PIPS part number U34423C08ST19P
Right Angle cable entry PIPS part number U34423C0819P

Mating Cable with connector A350/33 (unterminated at other end)

Contact No	*Connection*	**A350/33 Cable** *Cable wire colour*
A	Ethernet XR-	
B	Ethernet XR+	
C	Ethernet/RS232 Screen	Drain wire of individual screens
D	Ethernet XT-	
E	Ethernet XT+	
F	Camera 1	Red
G	Camera Screen	
H	Camera 2	
I	Battery Negative	
K	Battery Positive	
L	Screen	Overall screen drain wire
M	Trigger 1 (Current out)	White
N	RS232 RXD	Orange
O	RS232 TXD	Yellow
P	External video	
R	Relay 1 (NO)	Green
S	Relay 2 (Common)	Black
T	Relay 3 (NC)	Blue
U	Trigger 2 (Current in)	Grey

Table A.2.2(B). P372 Connector - Rear Connector with Pin Contacts

A.2.3. RS232 Signals

Signals are RXD – Receive Data by P372
TXD – Transmit Data from P372

The RS232 "common" conductor is shared with the Ethernet "common" conductor.

A.2.4. Trigger Input

The 372 camera has an optically isolated trigger input. External current must be provided to enable correct operation. An example circuit, operating from 12V, is shown below. Other voltages can be used by changing the value of the series resistor so as to maintain a current of at last 10mA. The forward voltage drop of the LED in the opto-coupler is typically 1.5V. The poly-fuse in series with the diode of the opto-coupler is self-resetting.

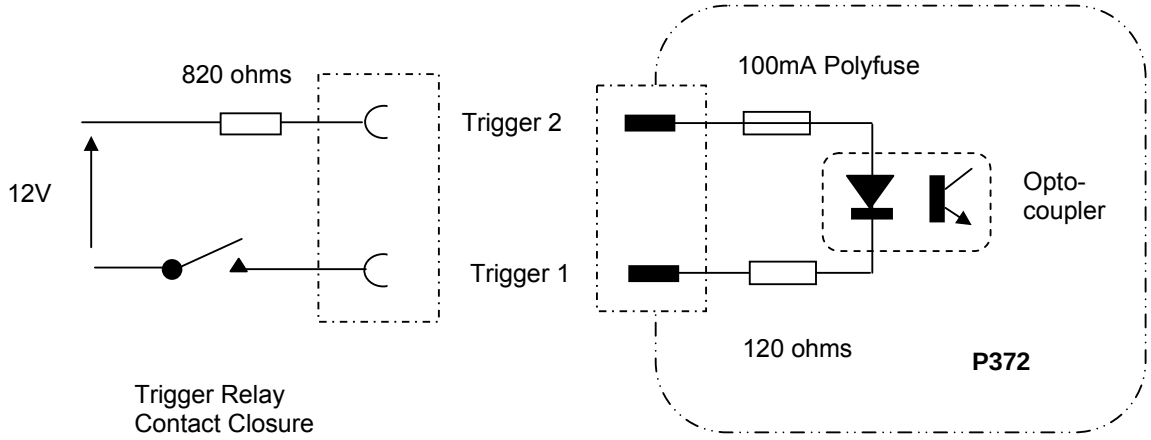

Fig A.2.1. Typical Trigger Circuit

A.2.5. Relay Contacts

A changeover relay is provided to connect to other equipment. Using a relay ensures isolation as well as felixibility so far as voltages and polarities are concerned.

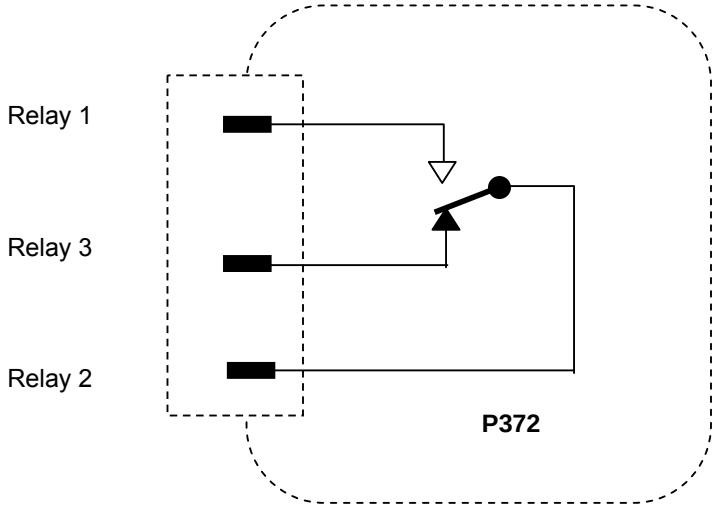

Fig A.2.2. Relay Configuration

Appendix 3 P372 General Configuration

3.1 Overview

P372 system configuration information is stored one of two places. Low level and system configuration information is stored within EEPROM. High level application information is stored within a file. This file may be located within any of the available file systems.

A small number of configuration options are accessible from the EPROM boot loader as these configuration options must be set in order to start or to load software into the P372.

3.2 Connection & Control

Initial control and configuration of the P372 must be done via the engineering access serial (RS232) port (the debug port). This serial port is a 3-wire connection and is by default configured for 19200bps, 8 databits, 1 stop bit, XON/XOFF protocol. Once basic network configuration is complete, then it is possible to perform configuration and control via a single TELNET connection over TCP/IP protocol.

The P372 will generate unsolicited monitor and debug messages on the engineering access port. The volume and detail of this information stream may be managed via various configuration options described below. In addition this data stream may also be monitored via a TELNET connection. This is described in further detail below.

Communication with the P372 control software is performed via a Command Line Interpreter (CLI). The CLI indicates that it is ready to accept further commands by means of a double chevron prompt:

>>

3.3 EPROM configuration

(These options are duplicated within the application CLI)

Command	Comment
show boot	Shows boot mode and file
set boot dev {filespec}	Set program boot file and device. Device may be: ATE, prom, ftp or file (see section 3.3.1. below)
show date	Shows date and time
set date dd-mmm-yyyy hh:mm:ss	
show conf	Show name of confiuration file
set conf full_filespec	Set source for application configuration file
show server	
set serial nnnn	Set the unit serial number. This entry requires a security code.
set ethernet aaaa bbbb cccc	Set the unit hardware Ethernet address. This entry requires a security code.
set server aaa.bbb.ccc.ddd	Set default ftp server IP address
set internet aaa.bbb.ccc.ddd	set the IP address of the 372
set password	

3.3.1 Boot device

ATE	No application loaded, minimal hardware configuration performed, network connection is not enabled.
prom	No application loaded. Hardware configured. Network enabled.
ftp	Application will be loaded across network link via FTP protocol.
file	Application will be loaded from flash file system.

3.3.2 Examples

```
>>show conf
config file: flash;system.ini
>>set conf mem:/system.ini
config file: mem:/system.ini
>>
>>show boot
boot mode is: FTP  , default file: 372x2a.z00
>>set boot file 372x2a.z00
boot mode is: FILE, default file: 373x2a.z00
>>
>>show server
system serial number: 13
ethernet hardware address: 0800 372b 0013
internet address: 10.10.10.100
server address: 10.10.10.254
>>
```

3.4 Application configuration

Configuration information described herein is kept in the file named in the system config parameter. By default this would be flash;system.ini. But for development it will be mem:system.ini. Note use of colon and semicolon as the path descriptor separators. See next page.

Command		Notes
`capture show`		
`capture set filter 0xhhhh`		This field is a numeric value either decimal or hex. In which each bit enables a filter to preselect plates.
	`0x0000`	(no bits set) all plates rejected
	`0x0001`	process images at maximum rate subject to the queue never having any pending images
	`0x0002`	Images are captured on time expiry set by “capture set time”.
	`0x0004`	Plate trigger must move a defined number of pixels (horizontal or vertical) before a new plate is accepted
	`0x0008`	Reject images if ALPR queue length exceeds set cap queue parameter
	`0x0010`	Accept all images, ignoring plate trigger
	`0x0020`	NYI - select groups of images to encompass a complete exposure sequence
	`0x0040`	In any series of images separated by a number of blank fields (set cap blanks) with no plate trigger, only forward the image with the best confidence figure for further processing
	`0x0080`	Only enable capture when fast trigger gate is open (see trigger below)
	`0x0100`	Only enable capture on any camera when the detector for that channel shows that a vehicle is present
	`0x0200`	Capture all images with a valid plate detect - beware can flood and stall
	`0x0400`	Forward best image on completion of fast trigger gate. Requires 080 or 100 above.
	`0x0800`	Images will be monitored according to other options set. However no image will be forwarded until after the completion of a trigger event.

Cont/

Command		Notes
`capture set time nn`		Set the minimum number of ms to elapse between image samples. Only used if filter bit 0x02 (filter_time) is set
`capture set vertical`		Set the minimum number of lines the plate trigger must move before a new image is accepted. Only active if movement filter bit 0x04 is set. If set to 0, this filter is off
`capture set horizontal`		Set the minimum number of horizontal pixels the plate trigger must move before a new image is accepted. If set to 0, this filter is off.
`capture set queue`		Set the maximum number of plate images permitted in the ALPR input queue. Reducing this figure will improve latency at the expense of lost images in a busy system.
`capture set wide_field`		Set parameter for the wide field detector (NYI);
`capture set blanks nn`		When filter_best is set, this value represents the number of blank fields used to detect the separation between vehicles
`capture set count nn`		If a vehicle is stationary in front of the camera, no “best” plate can be detected until the vehicle has moved off. After this count has expired the “best” plate so far will be forwarded. Whilst the plate remains stationary, the count before the next forward is increased by count on each event
`capture set factor`		Not in use
`capture set enable nn`	`0x0001`	Default value
`capture set best`		Not in use
`capture set upper_limit`	`nn`	Tell plate detector to ignore any trigger signal appearing outside this limit Where nn is pixels from upper edge of field
`capture set lower_limit`	`nn`	Tell plate detector to ignore any trigger signal appearing outside this limit Where nn is pixels from lower edge of field
`capture set left_limit`	`nn`	Tell plate detector to ignore any trigger signal appearing outside this limit Where nn is pixels from left edge of field
`capture set right_limit`	`nn`	Tell plate detector to ignore any trigger signal appearing outside this limit Where nn is pixels from right edge of field
`capture set debug`	`0xnn`	Set bits to turn on debug messages within capture system

Cont/

Command		Notes
capture set age	nn	When any of the "capture best" filters are enabled, any image older than nn ms will be discarded and replaced with a newer image.
capture set duplicates	n	set n to 1 to reject succesive plate events showing the same plate.
capture set age_bias	n	set n to 0 to disable biasing of plates. Set to a positive number to bias toward the earlier plates in a sequence. Set to a negative number to bias toward the later plates in a sequence. Suggesteted values +/- 5
capture set direction	0xnnnn	set bits in nnnn to accept plate moving in specific directions. See below for fuller details
capture set closeloop	n	set n to 0 to disable the closed loop feedback systems used to control cameras, or 1 to enable them. See closeloop set commands for specific configuration. Closeloop only works properly with self triggered systems, not externally triggered ones.
html sho		
html set root diskspec		Set the html device & disk name Eg: >> set html root flash;
html set home filespec		Set the html home page Eg:>> set html home html372.x09
html set debug nn		set debug levels for the html/http server
html set keep_open n	n=0	connections are closedafter processing one URL
	n=1	connections stay open until either they are closed by the client or until 20 seconds have passed without any activity
jpeg show		
jpeg set host aaa.bbb.ccc.ddd		Set ftp host to save jpeg files
jpeg set account aaaaa		Set ftp host account name
jpeg set password ppppp		Set ftp host password
jpeg set separator		Field separator to use when building long file names
jpeg set list n	n=0	No list file
	n=1	List file by date in dos:/jpg

Cont/

Command		Notes
jpeg set time nn		Ftp connection timeout
jpeg set name n	n=0	Short JPEG file names based on event number
	n=1	Long jpeg file names built from date,time,cam,plate,conf
jpeg set quality nn		Set the JPEG compression quality where nn is given in the range 1-99 with a default value of 50
jpeg set patch n		Where n may be 0, indicating that the whole image must be compressed or 1 to just compress the plate patch
jpeg set box n		If patch is set to 0 so that a whole image is recorded, then setting this option to 1 will draw a box arround the patch area of the image.
jpeg set dir_size		JPEG files are placed in a subdirectory under top level directory jpg. This directory is limited to nnn files, after which a new directory will be created. For reasonable efficiency on the 372 local disk this directory size should not exceed about 250 entries
jpeg set aspect n		Change the aspect ratio of jpeg images. NB PIPS Technology quotes performance for standard aspect ratio. This parameter does not affect patch images that are always unmodified.
	n=0	Standard aspect ratio. A video field is compressed unmodified at an aspect ratio of 8x3
	n=1	Horizontal data is subsampled 2:1 to give an image aspect ratio of 4x3
	n=2	Vertical data is doubled to give an image aspect ratio of 4x3
jpeg test		Capture JPEG test image
show kermit		
set kermit device devname		The Kermit module needs to know which physical device is to be used for file transfers. Options are flash, or dosfile (the default).
set kermit debug nn		If non zero enables Kermit debug facilities

Cont/

Command		Notes
`log show`		
`log set mode 0xhhhhhhhh`		Log setting mode according to bits set in parameter:
	`0x0000`	No data logged
	`0x00010000`	Log plate result to file - summary information only
	`0x00000001`	Log plate result to stderr - summary information only
	`0x00080000`	Log all results to file
	`0x00000008`	Log all results to stderr
	`0x00040000`	Log timeout detection between plates to file
	`0x00000004`	Log timeout detection between plates to stderr
	`0x00020000`	Log plate detector output to file
	`0x00000002`	Log plate detector output to stderr
	`0x00010000`	Log any missed plates to file. A missed plate is an image which has generated a plate trigger but for which no plate can be found.
	`0x00000001`	Log any missed plates (see above) to stderr.
	`0x00200000`	When filter_best is in use, log to file the decision to forward a plate.
	`0x00000020`	When filter_best is in use, log to stderr the decision to forward a plate
	`0x00400000`	Generate brief format plate log to file
	`0x00000040`	Generate brief format plate log to stderr
	`0x00800000`	Log plate string to dos:/bmp/lost.log if output Q becomes full
	`0x00000080`	ditto
	`0X01000000`	Enable logging to file of OEM specific debug messages
	`0x00000100`	Enable printing of OEM specific debug messages

Cont/

Command		Notes
log set device path		Specify the device and (if relevant) directory in which the log files will be created. Do not use flash as a log device!
log set size nn		Set the maximum size for a log file. When this size is exceeded the current log file analyse.log will be renamed analyse.lnk and any existing analyse.lnk will be deleted.
log set nzip nn		if this option is set non zero, the *.lnk files created above will be zipped. A new zip file is created until nn is reached, at which time the oldest file will be overwritten.
show modem		
modem set type		Set modem type. valid types are:
	gsm	Seimens M35 or M45 GSM modem
	hayes	most Hayes compatible modems - tested with usRobotics
modem set init	sssss	set the modem initialisation string to ssss for example for a gsm modem this might be: ATS0=1&D2+ifc=2,2
modem set pin	pppp	A GSM modem requires a security pin to access the sim.
modem set format	ffff	Set the communication format used by a GSM modem to fffff
modem set network	nnnn	Set the GSM communications network specifier to nnnn
modem set enable n	0	Modem disabled
	1	Modem enabled
modem set verbose n	0	No modem reports
	1	Minimal reporting of modem connection
	4	Report modem configuration process & handshake changes
modem set net n		Set network connection options
	0	No network connection, modem connects directly to a CLI
	1	After connection the modem line is switched into a SLIP connection
	2	After connection the modem line is switched into a PPP connection

Cont/

Command		Notes
modem set net_host	a.b.c.d	Set modem slip or ppp host address to a.b.c.d
modem set net_peer	a.b.c.e	Set modem slip or ppp peer address to a.b.c.e
show raw		
set raw patch n		Where n may be 0, indicating that the whole image must be saved or 1 to just save the plate patch
set raw dir_size		raw files are placed in a subdirectory under top level directory raw. This directory is limited to nnn files, after which a new directory will be created. For reasonable efficiency this directory size should not exceed about 250 entries
set raw info n		If n==1, embed log data as a text string into the first video row of the image.
set route xxxx		Sets the output route from analysis system. The actual processing routes available are system software build dependant. OEM systems may have specific routes enable. The following routes are available on all systems:
	null	Image is discarded
	raw	Image is saved on disk in raw binary form
	jpeg	Image is saved in JPEG format
	bmp	Files are saved in BMP format
	client	Plate patches and exposure information are passed to a TCP/IP client on a host system
system show		
system set flex filespec		Specify the flex file to be loaded. A full file specification is required eg: set flex file flash;372aflex.x21
system set exposure filespec		Name of file to use for exposure table. This is a machine readable file
system set startup filespec		Name of script file to run at startup.
system set time_server		Specify the server IP address to be used for the internet "daytime client" and SNTP requests. Set this to 0 to turn off calls to a time server

Cont/

Command		Notes
system set daytime_port		Set the port number for the daytime server. This will default to 13, the usual daytime port number. However if an OEM specific daytime server is in use, then the specific port number can be configured here.
system set time_zone		Set the number of hours offset (+/-) from UTC time required. NB this offset must also take account of daylight saving if required. The 372 does not correct for daylight saving time.
system set brownout nn		Set the number of ms during which power may be down as a result of a supply brownout
system set powerdown nn		Set the number of ms the power fail system will wait for operations to complete before finally pulling the power
system set plate_type nn		Set country code. This option selects for various system wide parameters that are country or area specific eg plate aspect ratio.
	00	UK type plates
	01	USA type plates
system set camera_config	0	Default value
system set ftp_debug	00	ftp system operates silently
	1-n	ftp system reports transactions with server
system set tn_timeout	nn	Set telnet connection timeout in seconds
system set cc_eds	0	Default value
system set reload	nnnn	When set this options forces a periodic system software reload where nn is seconds
system set nmea	0	Default value
trigger set		
trigger set mode nn		Low byte controls fast trigger modes
	0x0000	Trigger not active
	0x0001	Trigger on elapsed time after trailing edge of event
	0x0002	Trigger on elapsed distance after trailing edge of event. distance is in mm This is converted to a time by using speed measured through gate
	0x0004	Event is rising edge on input.

Cont/

Command		Notes
`trigger set distance dddd`		Set distance in mm between rising and falling edges of trigger timer. This can be used to measure speed through the “gate”
`trigger set speed ss`		Set threshold speed (mph) below which trigger events are ignored If 0 then all events are accepted.
`trigger set delay nn`		If mode is set to time then Set the number of ms to elapse between trailing edge of trigger event and action Else if mode is set to distance then this is the delay in mm at measured speed through the gate
`trigger set open nn`		After delay has expired, capture will be enabled for the period (ms) or distance (mm) set here. For this to operate, use filter mode *filter_on_trigger*
`trigger set mode`		Hi byte controls slow trigger modes
	`0x0100`	Enable detector on camera
	`0x1000`	Detector operates on lo going edge (default hi going)
`trigger set debounce nn`		After detecting an edge on any input, that input will be ignored for period nn ms. Note that the debounce only operates on the slow inputs.
`trigger set units`		
	`0`	Detector open period is measured in ms
	`1`	Detector open period is measured in fields
`trigger set period`	`nnn`	Simulate a hardware trigger every nnn ms
`trigger set mask`	`0xnn`	When simulating, send triggers to channels corresponding to bits set in this mask

3.4.1 Mode and Sync

Command		Notes
`set mode`	`0x00`	Default value.
`set sync`		set video sync rate
	`525`	NTSC/EIA
	`625`	PAL/CCIR

3.4.2 Camera exposure configuration

Command		Notes
`set cam n`		Set illumination and exposure for camera 1
	`e:n`	Update is for table entry n If this parameter is not present then it is assumed that the update is for table entry 1
	`p:n`	This position is for camera type 0 - master mono 1 - slave mono 2 - master colour 3 - slave colour
	`v:n`	Set view type 0 - plate view 1 - overview
	`m:n`	Set multiple This option sets the number of table entries cycled. It may take values 1-8
	`f:n`	Set flash time. Valid entries are 0-7 0 – off (use for overview camera) 1 – 0.10 ms 2 – 0.13 ms 3 – 0.195 ms 4 – 0.260 ms 5 – 0.390 ms 6 – 0.580 ms 7 – 0.780 ms
	`s:n`	Set shutter time. Valid entries 0-3 For IR camera 0 – 0.08 ms 1 – 0.2 ms 2 – 0.5 ms 3 – 1.0 ms For overview camera 0 – 2 ms 1 – 4 ms 2 – Auto shutter 3 – 1 ms
	`g:n`	Set gain value. Valid entries are 0-7. For colour overview camera Auto gain is forced.
	`w:n`	Set plate width for this channel (pixels)
	`t:n`	Set plate threshold for this entry (typically 10-60)

NB:

The camera(s) may have as many as eight exposure settings. However only three exposure settings are required in a typical sequence. The extra entries are required to define what the camera(s) will do when its output is not being processed. When the camera output is not being used the flash control should be set to 0.

3.4.3 Example exposure settings

For fast traffic, a suggested starting point would be:

F	G	S
7	6	1.0
5	6	0.5
3	6	0.2

System geometry would normally be set to give a plate size of about 25% of field of view. Typically this will mean a plate width of 220 pixels. A starting point for threshold would be about 40.

This should be implemented as a script (see below). The following would be the script fragment to configure camera 1 for the above:

```
* configure exposure
set cam 1 e:1 p:0 v:0 m:1 f:7 s:3 g:6 c:0 w:220 t:40
set cam 1 e:2 p:0 v:0 m:1 f:5 s:2 g:6 c:0 w:220 t:40
set cam 1 e:3 p:0 v:0 m:1 f:3 s:1 g:6 c:0 w:220 t:40
.
.
set cam 1 m:3
```

Current exposure settings may be examined from the CLI with:

```
>> cam script
```

For historical reasons there is another command which provides information about exposure settings. This command is illustrated below. However, beware that this command does not now display a full and informative picture of the camera settings.

```
>>show itab 1
camera 1
   f g s  t
1: 4 5 .2 40 sm plate 220
2: 6 5 1. 40 sm plate 220
3: 5 5 .5 40 sm plate 220
4: 1 4 1. 50 sm plate 220
5: 1 4 1. 50 sm plate 220
6: 1 4 1. 50 sm plate 220
7: 1 4 1. 50 sm plate 220
8: 1 4 1. 50 sm plate 220
table length = 1
>>
```

3.4.4 Direction Selection

The P372 will normally accept all plates moving through the field of view (subject to selection filters). However the system may be configured to accept plates from vehicles moving either toward or away from the camera. See option **cap set direction** above.

In order to determine direction the P372 observes the movement of a detected plate within the field of view. The P372 must therefore have at least two detection events for any plate. On high speed traffic under conditions of poor visibility and/or with a poor plate the P372 may only detect one plate from a triple flash pattern and therefore will be unable to make a reliable determination of direction.

The direction parameter 0xnnnn specifies which plates will be accepted as shown below. Bits are combined to select more complex arrangements.

Parameter	Plates Accepted
0xnnn0	Accept all plates on the camera – the default
0xnnn1	Accept vehicles moving toward the camera
0xnnn2	Accept vehicles moving away from the camera
0xnnn4	Accept vehicles when the system cannot determine reliably whether they are moving toward or away from the camera

Setting **capture_debug** flag **0x0800** will report the direction of observed plates and will also report when a plate is dropped because its observed direction does not meet the required criteria.

3.4.5 Closed Loop

The closed loop algorithms in the P372 use the results of ANPR and triggering to feedback into the system to adjust the camera parameters to try to capture more plates. These algorithms are only suitable for use on self-triggered systems (for example capture set filter 0x40), **not** on externally triggered systems.

In essence turning on these systems should lead to better capture rates, and means that (with both systems on) you do not need to set up the camera exposure tables and they will auto-adjust depending on the weather and lighting.

There are two parts to the system: threshold control and brightness control.

Threshold control: This system **only** adjusts the threshold values of currently configured cameras (e.g. the t: part of set cam). It will adjust each individual flash setting individually and is best used on systems set up to do multiple flashes (e.g. m: >= 2). Turning on threshold control is safe to use with overview cameras in any configuration.

Brightness control: This system adjusts the whole of the camera table for each camera it is enabled on (It is possible to chose which cameras have this enabled). Therefore most of the set cam commands will no longer work properly (You will still need to set plate width and cable lengths). It will set up each camera to triple flash and will automatically adjust all of the flash, gain and shutter settings for you. It receives assistance from the threshold control system, so it is recommended to have that enabled as well as this system if you want to use brightness control.

Brightness control does not work with all camera configurations – it will only work properly on channels which have one camera on them, and that camera is not an overview.

None of the closeloop systems will operate unless “capture set closeloop 1”.

Command			Notes
closeloop set			
	threshold_on	0	set to 0 to turn off threshold control
		1	set to 1 (default) to enable threshold control
	brightness_on	0	set to 0 to turn off threshold control
		1	set to 1 (default) to enable brightness control
	bright_mask	0x0001	Default value
	bright_cutoff	180	This is a value used to control part of when the brightness control will try to make the image dimmer. If a plate image is overexposed with more than bright_cutoff number of pixels overexposed then we will think that this image should get dimmer.
	bright_def		This option sets how bright the cameras will be set to at system startup. There isn't really any need to adjust this as it does not affect long-term settings, just how long the system will take to settle after boot.
		0	Start off at the dimmest setting
		7	Start off at the brightest setting
	debug	0x0000	Sets bits for debugging closedloop operation 0x0001 – for threshold control 0x0002 – for brightness control

3.4.6 ALPR Configuration

(PIPS Technology AUTOPLATE specific)

Command			Notes
anpr show			
anpr set			
	debug		set to 0 to turn off all internal debug messages within ALPR module
	enable n	0	set to 0 to disable ALPR call in live analysis chain
		1	set to 1 (default) to call ALPR system

Cont/

Command			Notes
anpr set	retry	n n	if plate ALPR confidence is <= nn then retry ALPR using whole image. This facility is designed to capture some of those images where the trigger is taken off a light or similar. nn = 0 never retry nn = 100 always retry
	ir_plate	0	image is from standard camera
		1	image is from IR camera (default)
	detect	0	simplest – fastest plate detection
		7	intensive – slowest plate detection (bit options)
	ap_debug	n n	autoplate internal debug control (default 0)
	plate_shape	0	linear plate (default)
		1	square plates
	whiteonblack	0	plates are expected to be black on white
		1	plates are expected to be white on black nb: detect must have bit 0x04 for this mode to work
	multiple	n n	set number of approaches taken to locate and segment plate. 0 will allow software to use as many as required, 1 - 3 will vary from minimum to maximum
	roi	n	set image area submitted as patch
		0	image area is that reported by the hardware plate finder.
		1	the image are will be as reported by the anpr package so will be almost the exact size of the plate
		2	the image area will be as 1 above but increase by 12.5% in each directiom
		4	The image width is increased sufficiently to allow for a superscript title area to be added above the image.
	hazard	n	wnen set to non xero enable software to locate hazard plates. NB: plate shape above must also be set to 1

3.5 Plate Database

The P372 incorporates a real time fast access plate database. In its standard form this database may be used as a filter for plates either acting as a white list filter or as a black list filter.

A white list filter discards all plates found within the database. Such a facility might be used in a tolling application where the white list will contain all vehicles for which a toll has been paid. Thus only those plates belonging to potential violators would be forwarded for processing

A black list filter discards all plates not found within the database. Such a facility might be used for example in a system searching traffic for stolen vehicles. Only plates found within the database will be forwarded for further processing.

OEM applications prepared by PIPS Technology for specific customers may include further data within the database. For example a security system might also carry vehicle make and colour.

Command		Notes
`pdb show`		show current pdb configuration
`pdb set enable n`		
	`0x00`	lists disabled – no lookup performed
	`0x01`	blacklist – forward plate if found
	`0x02`	whitelist – forward plate if not found
	`0x03`	Always forward the plate. In this case the lookup is performed. Data returned from the lookup accompanies the plate to affect further processing. This option is only valid for specific OEM applications prepared by PIPS Technology
	`0x80`	If this bit is set, then if a fast lookup fails, a detailed lookup is performed. **WARNING:** do not use this option if the list contains more than a few hundred entries.
`pdb set file filespec`		set the default database filename
`pdb set separator`	`ss`	set field separator to any character in string ss
`pdb set info`		not used
`pdb set debug`		set to non zero to enable debug
`pdb set hashsize`		set the size of the database hash table
`pdb clear`		clear all entries from current database
`pdb load {filespec}`		add file to current database. If filespec is given add this file, else load the default file. If the requested file is not found on the local disk the default ftp server will be asked for the file.
`pdb save filespec`		save current database to filespec
`pdb lookup ppppp`		(test facility) search database for given plate ppppp
`pdb insert ppppp`		insert plate ppppp
`pdb delete ppppp`		delete plate ppppp
`pdb amend ppppp`		amend record for given plate ppppp (OEM specific)

When saving or restoring a database from disk, the file is stored in simple ASCII text with records delimited by newline. Fields within each record, if they exist, are by default delimited by '|'. This is done to permit comma or space delimited sub fields within each field, as for example with date and time. The first field in each record is always the plate. Subsequent records are application specific.

The default field separator may be changed. The separator specification is a string of possible characters, so multiple separators may be used. The separator list always includes space and newline. When a database file is saved to disk the first character in the specified string will be used as the field separator.

When a database is saved to disk it will be saved unordered. In its standard form the database stores nothing but the plate. Such a system is useful for simple white or black list matching. OEM specific implementations may store additional data with each plate.

The hash table size is a parameter that is only read at system start. Therefore, after changing this parameter it will be necessary to restart the unit for the change to take effect. This parameter should be approximately 1/20 of the expected worst case maximum database size. It must be a prime number. A suggested set of values are:

Hash Table Size	Notes	For Database Size	Notes
1009		1000 - 20,000	
5003		5000 - 100,000	
10007		10,000 - 200,000	
50021	default	50,000 - 1,000,000	
100003		100,000 - 2,000,000	Extra RAM required
500009		500,000 - 10,000,000	Extra RAM required

3.5.1 Performance

The database is normally configured as an in memory system. Therefore the available size of the database is constrained by the amount of available memory. The standard system would probably have about 16Mbytes available memory, enough for perhaps 500,000 vehicles, depending upon the information to be associated with each vehicle.

By default only exact matches are accepted. No facilities exist for wild card (or any other form) of imprecise matching.

Search time per plate is insignificant (typically <75uS) and is not substantially affected by the size of the database. Load time from local disk is approximately 15000 plates per second. Thus loading a database of 500,000 vehicles will take about 30 seconds. This does not include transfer time from a host system. Load time and search time will not be improved if the database is supplied ordered.

If bit 0x080 is set within the pdb enable configuration flag then the system will first use the fast match system and if this fails to locate the plate will then use an exhaustive substring match against all the records in the database. This approach is very slow. The plate database should be restricted to a few hundred vehicles. This approach is more appropriate for situations where many plates must be checked against a small list as for example in a controlled access situation.

3.6 Communication & File Transfer Facilities

Command	Notes
`kermit server`	
`kermit send`	
`kermit receive`	
`ftp get filespec`	Copies filespec from the server directory to an identical name in the current directory
`ftp get fromfile tofile`	Copies fromfile from the server to tofile, where tofile may be a full pathname
`ftp put fromfile`	Copies fromfile from the 372 to an identical name in the default server directory.
`ftp put fromfile tofile`	Copies fromfile from the P372 to tofile, where tofile may be a full pathname
`ftp mput fromspec`	The fromfile may contain wildcards
`ftp append fromfile tofile`	Appends 372 fromfile to the end of tofile on the server.
`ftp dir`	List server current directory
`ftp ren`	Rename file
`ftp del`	Delete file
`ftp md`	Make directory
`ftp rd`	Remove directory

NB: the kermit system cannot handle filesystem or directory specifiers. So by default it will read/write into the current directory. As it may be necessary to transfer files directly into flash, use:

>> set kermit device
(where device is flash; or dosfile;) to select the physical device to or from which transfers must be made.

The ftp subsystem provides a fairly complete client implementation. However, by design it is not interactive. Each invocation runs to completion, encompassing logon, transfer and disconnect. The ftp system uses the default system server and account details. All transfers are assumed to be in image mode.

In addition, the 372 provides a minimal http server. An embedded home page allows for selection and interrogation of various data stores.

3.6.1 WEB Management and Reporting

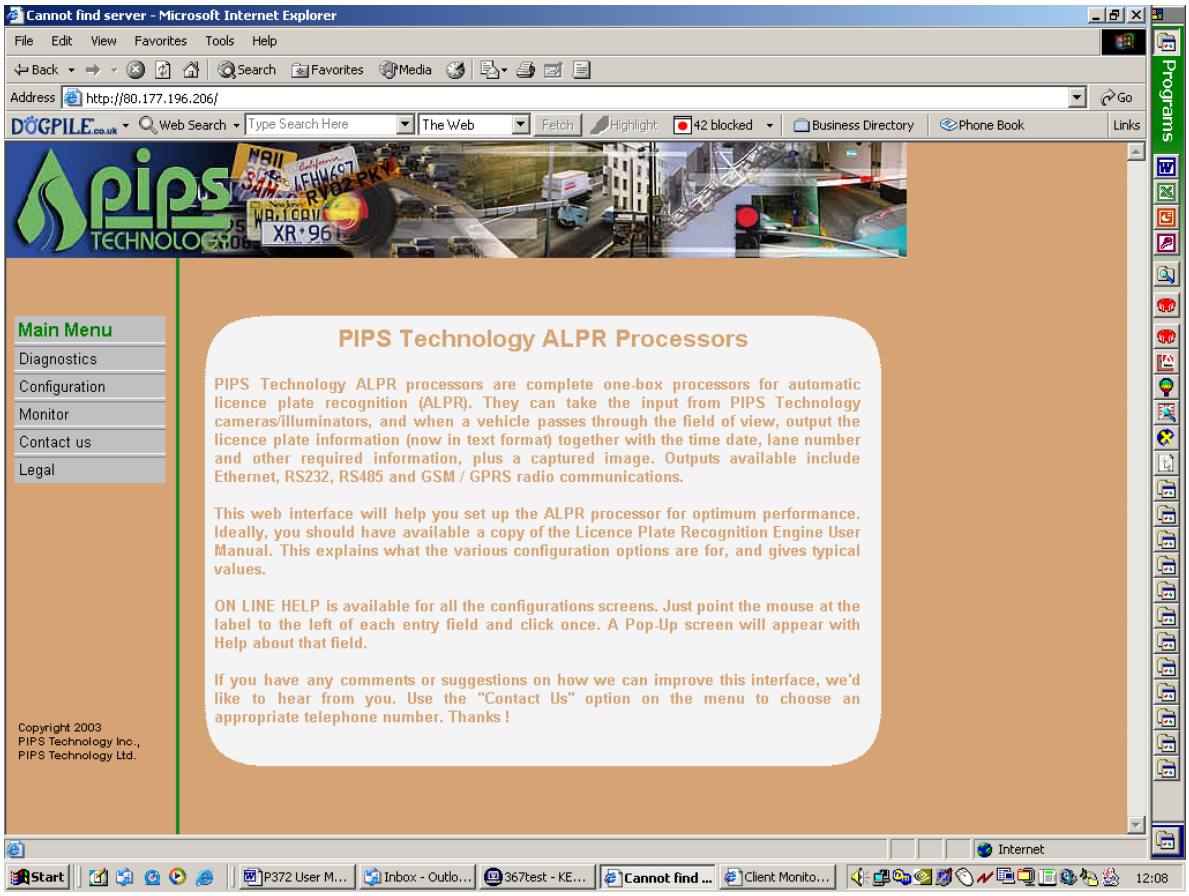

Figure 3 Example home page for the P372

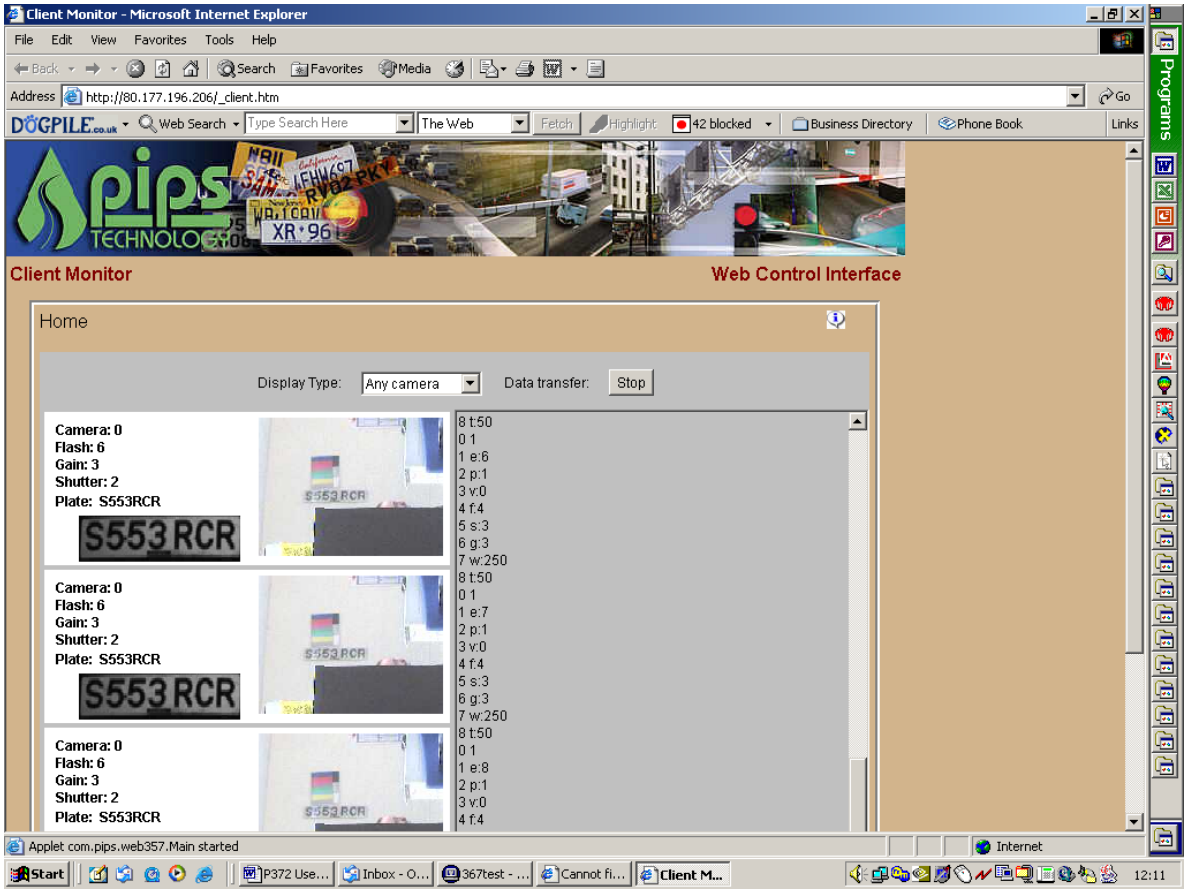

Figure 4 Example Client monitor page for the P372

3.7 Trigger System

The trigger/detector system provides an input. This input is fed to the P372 processor so time measurements can be made. The trigger input can also be used to wake the P372 from its two doze modes.

The system can provide a longer latency detector designed for enabling a camera channel in response to an external vehicle detector as might for example be used at a car park barrier. This system is not designed for the detection and location of high speed vehicles. The input may be set to detect on low or high going edges. The input may have a “dead time” (debounce) set during which further triggers are ignored.

3.8 BMP Support

Command		Notes
bmp show		Show current bmp settings
bmp set host *nnn.nnn.nnn.nnn*		Set bmp ftp host. Use dotted decimal notation only eg 10.10.10.254
bmp set account *accname*		Set bmp ftp server account name
bmp set password *passwd*		Set bmp ftp server account password
bmp set separator p		When long file names are generated by the bmp write process use this character as a field separator
bmp set time nn		The bmp system will hold an ftp connection open between image writes until nn seconds without an image has passed. The ftp server should be set to time out connections at a period exceeding this number by about 30 seconds
bmp set patch n		Set scope of image saved in ftp directory
	n=0	Full image is saved
	n=1	Plate patch only is saved
	n=2	320x240 image centred on patch is saved
bmp set info n	n=0	No info saved
	n=1	Plate tag is saved as string in image buffer
bmp set debug n	n=0	No debug messages
bmp set name n	n=0	Use short image file names based on event number
	n=1	Use long filename
bmp set dir_size n	n=0	Has no effect
	n>0	Creates sub directories of the form Baaaa each of which will have dir_size entries. aaaa will be event_id/dir_size

Cont/

Command		Notes
bmp set list filespec		If filespec exists, then a list of created bmp files (a log file) will be built in the specified local drive. Note that for performance reasons the list is not built on the ftp server. Set to 0 to disable.
bmp set flags		not used
bmp set box	n	If n is non zero and a full image is being saved, then a box will be drawn around the region of interest containing the plate patch
bmp anpr filespec		Read filespec from ftp server and process through ALPR engine
bmp list listfile outfile		Open file listfile and read list of images to process. Each image is fetched from the ftp server and is processed through the ALPR engine. The results are posted to file outfile. At completion of the list, the overall score is computed, comparing the file name with the read plate. If listfile cannot be found locally then the default ftp server will be searched. If the file is a remote file then the outfile will be transferred to the ftp server.
bmp score filespec		filespec ids assumed to be the output from the bmp list command. This facility recomputes the read score.

3.8.1 Test System

This is a facility provided for testing the performance and behaviour of the ALPR system. It provides the system with the capability of processing a set of BMP files and comparing the processed results with the correct number plate readings.

Reference files used for scoring and regression testing of the ALPR subsystem will be BMP format.

Files must be given a name of the form A123BCD.bmp. These files should be saved in the bmp account default ftp directory. Create a list of these files in the same directory. eg:

```
ls –c1 *.bmp > inlist
```

Then on the P372 process the files

```
>> bmp list inlist results
```

This will process each file, and record the result in in file “results”.

The result plate string is compared with the file name to generate the score.

Each line has the form:

```
plate_name    anpr_result   time  score
eg

P512DEG     P512OEG     837ms       0
```

The “score” represents a percentage comparison between the input file name and the output from the ALPR engine, where 100 represents identical strings.

At the end of the run, total plates, total errors and mean processing time are reported. These final statistics may be recreated by reprocessing the result file

```
>> bmp score result
```

an example score result follows:

```
902 plates processed, 820 correct, 82 wrong, score:90%, mean
time:256ms
0: >100  820 plates
1: > 95    4 plates
2: > 90    2 plates
3: > 80   20 plates
4: > 70    3 plates
5: >  0   53 plates
```

3.9 Batch Processing

To assist in the configuration process there are two batch process commands available within the CLI. These are:

Command	Notes
install list	If list does not exist, attempt to copy list from the ftp server into the current directory. Once list exists, open it, then attempt to copy each file in the list from the ftp server into the current directory.
script {-q} script_name	Execute CLI script script_name. The script must reside in the root of the ram disk. If the file script_name does not exist, then an attempt will be made to fetch the script from the ftp server. Once the script exists, each line in script will be passed through the CLI. All CLI commands except those requiring interactive input may be placed in the script file. If the script was loaded from a remote file server, then after completion it will be deleted. Empty lines are ignored. Comment lines start with !#; or * Option -q suppresses some of the messages.
bmp script	Some command blocks have the ability to prepare a script by listing current settings as though they were set commands. The example shown will produce set of commands to recreate the current BMP settings.
dump script	This facility dumps all of the systems current configuration settings to the terminal screen.

At system start the 372 will attempt to execute a startup script file. This startup script may be local or on the ftp server as described above. The filename used is defined as a system parameter.

If a script filename contains ':' it is assumed to be local and will not be requested from the ftp server.

3.10 Network Support

The P372 has a fairly complete TCP/IP stack. Communication links may be made either via 100/10baseT Ethernet or via SLIP or PPP on the modem port.

SLIP & PPP support direct connections. No facility exists to allocate (or accept allocated) IP numbers. Header compression is not supported. No authentication protocols are supported.

Network management and test facilities may be accessed via the net command set (though ping may be accessed directly).

Command	Notes
net gateway a.b.c.d	set system default gateway address
net mask	set system default network mask
net broadcast	set system default broadcast address
net show	
net set script scriptfile	Network configuration script run automatically at system start
net conf	Display network configuration
net route gateway route_ip gateway_ip	Set gateway for route_ip to gateway_ip. Both route and gateway are IP addresees in dotted decimal notation. route may be either a single address or may be a class of addresses.
net route mask address	Set the default mask to address where address is an IP address in dotted decimal notation
net route add	Not yet implemented
net route delete	Not yet implemented
net ping {options} address	See below
ping {options} address	
net slip	Not yet implemented
net ppp	Not yet implemented

3.10.1 Ping

In order to help debug network connections both the EPROM implementation and the application provide full responses to ICMP messages. In addition, the application provides a fairly complete implementation of ping. For a full description refer to any UNIX or LINUX documentation, but briefly the options to ping are:

ping {options} target

net ping {options} target

Ping		
	-c count	stop after sending (and receiving) count echo response packets
	-d	set SO_DEBUG option on socket
	-i wait	wait wait ms between sending each packet (default 500ms)
	-n	numeric address only
	-q	quiet output
	-r	bypass routing tables
	-s packetsize	use packets of size packetsize, default 56
	-v verbose	list other ICMP packets received (useful for debugging routing issues)
	-R	set the IP record route option (NYI)

If no target is given, ping will access the default server address.

3.10.2 Telnet

The P372 supports a telnet interface on the standard telnet port 23. Concurrent telnet sessions are not supported. The telnet connection may be set to automatically time out on no input activity. This is advisable when the system is configured for dial up connections.

```
>> system set tn_timeout nn
```

where nn is timeout in seconds. Setting nn to zero will turn off the timeout option.

3.10.3 Debug

The P372 may generate a stream of informational and debug messages. These messages will appear on the engineering port. In addition this information stream may be monitored over a network connection. This connection may be made via a TELNET connection to port 3577.

NB: Any error messages related to network operation failure or any messages generated before a network connection has been made cannot appear on this network port.

All EPROM messages (ie informational text, errors and configuration dialog) and the application initial start up messages will fall into this later group. In addition, the TELNET connection must be made before any messages can be seen. This will normally require manual intervention within the TELNET program.

3.10.4 Mail

Where the 372 is connected to an IP network, the system may send email automatically. It is envisaged that this facility will be integrated with the automatic data logging applications in specific OEM applications.

Command		Notes
`mail show`		
`mail set host`	`a.b.c.d`	set address of SMPT mail server at destination
`mail set addressee`		set destination addressee.this should be the full internet address
`mail set sender`		Set the name used as the originator of the message
`mail set userid`		Set the userid to be used to connect to the SMPT host —this may only be required for some host systems
`mail set timeout`		The SMPT client will attempt to connect for this period before giving up.
`mail set debug`	`0xnn`	set bits to turn on debug messages within SMPT module
`mail set retries`	`N`	Attempt to rety mail message n times
`mail set delay`	`N`	If a mail message has no been sent for n hours it may be discarded
`mail send {file}`		test application - sends a test message with optional uuencoded file attachment.
`mail q (file)`		Test application – place mail on q
`mail release`		Test application attempts to empty mail q to server

3.10.5 FTP

The 372 provides an ftp ***client***. No ftp server is yet available. See above for command syntax.

3.10.6 HTTP

A fairly simple single thread http server provides access to a debug & diagnostic facilities.

3.10.7 PPP

PPP is supported over the modem connection port. However at this time the support is minimal with no IP address assignment, authentication or packet compression.

3.10.8 Time Services

By default the 372 will attempt to interrogate an IP network time server 15 seconds after startup, and thereafter, every 5 minutes. The IP address for the time server is in the system configuration table ie:

```
>> show system
```

```
>> system set time_server n.n.n.n
```

If the time server IP address is set to 0 then this facility is turned off. See section on time synchronisation for further details.

3.11 Gzip & Gunzip

Files may be compressed or uncompressed at the command line using LINUX compatible utilities:

```
>> gzip fromfile tofile
```

Compresses fromfile into tofile. It is recommended that if the files are to be decompressed on a PC, then extension .gz is used, since this will mean that WINZIP can automatically recognise the format.

```
>> gunzip fromfile
```

Will expand fromfile to its original name.

No options are available to manage the compression process. These utilities use internal defaults.

A PC version of these utilities (gzip.exe) is commonly available.

3.12 Storage Subsystem Support

The 372 supports two distinct data storage systems:

Flash file system

DOS style ram disk

3.12.1 Flash File System

The flash file system is used for primary program store. The flash system may not become the current working directory.

When accessing a flash file the prefix flash**;** must be used to indicate this file system. Note use of semicolon. eg:

```
>> copy system.ini flash;system.ini
```

Will copy the configuration file from the current directory to the flash file system

There is a single flat directory structure. A maximum of 12 files may exist. Each file uses a minimum of 64k of flash store space. Each file name has an 8.3 format. However the 3 portion of the file name is used for version identity and plays no part in the name

matching process. CLI support for management of the flash file system is available. Flash file commands are preceded by fs, e.g.

```
>> fs format
>> fs dir
>> fs del fspec
```

3.12.2 DOS File System

The P372 provides local non volatile storage in an area of battery backed ram configured as a ram disk.

The ram disk system has a DOS 3.3 style file system. This limits file naming conventions to the DOS 8.3 format. The ram disk has a default capacity of 2 Mbyte. The maximum number of files is 64k (again, the maximum for a DOS 3.3 filesystem).

The file system type is dosfile and may be used as a prefix (as shown above for flash). However this is rarely required as this is the default file system type.

Media type is indicated by a prefix followed by a colon as with PC files system A: C: etc.

Medium	Prefix	Notes
ram disk	mem:	A small 2 Mbyte RAM disk is provided for fast data and event log storage. In addition it provides a useful place in which to keep configuration files whilst they are under development

eg:

```
>> type mem:/system.ini
```

types a file of the same name in the ram disk

A number of conventional commands are available to manipulate files within the DOS file systems

Command	Argument	Description
ls	{dspec}	List current directory (or named directory)
dir		Ditto
md	dspec	Create named directory in current directory
rd	dspec	Remove named directory
rm	(-r) fspec	Del file spec (wildcards accepted) option -r recursive delete
del		Ditto
ren	from to	Rename from to
cd	dspec	Change to directory
copy	from to	
cmp	fspec a fspec_b	Compare files a,b
tail	{-nn} fspec	Type the last nn lines (default 10) of file fspec
type	fspec	Type file
dump	fspec	Hex dump file
create	fspec size	Create test file of size blocks - time the disk activity

3.13 Time Synchronisation

In many applications it is necessary to provide time stamps on images or plates. Often these time stamps will be used to match the event capture with an external situation or event. Under these circumstances it is necessary that the P372 time reference be synchronised in some way with the external systems.

The P372 has an internal clock/calendar chip. This is used to set the system time on initial power up.

The time on this clock can be set manually via the set date or set time CLI commands. However this clock cannot be expected to maintain accurate synchronisation with the external world. Drift rate will be several seconds per day.

There are a number of mechanisms by which the 372 may be synchronised to an external time standard.

CLI interface command set date or set time	These commands could be generated automatically via an interface to an external system. Precision is likely to be +/- 1 second
network "daytime" server	Precision is likely to be +/- 1 second
network SNTP server	Precision will be of the order of 10ms giving time resolution to better than 100ms. NB. the 372 SNTP client does not take account of leap seconds.
optional GPS interface	This method will require an internal GPS receiver with NMEA output. Without a dedicated hardware interface for the 1 sec pulse, precision is +/- 1 second

Where possible, the optimal mechanism is to provide access to an SNTP server.

Whenever any external time synchronisation event occurs, the internal clock/calendar chip is updated with the correct time. This will permit the 372 to free run if access to the external time source is temporarily lost, albeit with time drift relative to the external system.

The P372 internal time is (by default) UTC time. File and event timestamps may be generated in local time format. Local time is defined as P372 internal UTC time + time_zone offset. The time zone offset can be any number of whole hours (+ve or -ve).

The P372 does not automatically track changes in daylight saving time.

Appendix 4 Vehicle Logging Software Notes

4.1 Overview

This document describes a system for logging vehicle licence plate numbers together with the plate patches. The data is collected via an Ethernet connection to a server running FTP. One server will be able to support many P372 data collection points. The exact number being dependant upon the capabilities of the sever.

This document describes the OEM portion of the software on the P372 specifically prepared for this purpose together with a suggested configuration scheme.

4.2 General Configuration

All 372 configuration options are set or modified via a command line interface (CLI). Commands to the CLI may originate either via serial or telnet connections or via script files. The system may be configured to run a script file automatically at startup. This script file may be kept locally or may be copied automatically from the default FTP server. PIPS Technology suggest that site specific configuration scripts are prepared and stored both locally on the site ftp server and at the central control point.

The 372 maintains a system event log reporting key system behaviour and may if required maintain a data log file (analyse.log) tracking image events. These files may be viewed via the CLI or transferred to a host system via ftp.

4.3 Example Functional Specification

The system extends the evaluation of ALPR equipment and associated communication links. The installed system will initially comprise:

At the outstation site:

- Two P372 cameras installed on an appropriate pole.
- Ethernet communication links from camera site to instation site or GPRS modems as an option.

At the instation

- PC running Microsoft Windows2000 sp4 or connected via Ethernet to P372 to provide data capture and storage. PIPS Technology can assist in the configuration and testing of the PC.

The objective is for the PC to make available log files providing a time stamped ALPR record for each vehicle observed by the camera. In addition, for each vehicle a JPEG compressed licence plate patch may be stored on the PC.

4.4 OEM Specific Configuration

A set of dedicated CLI options have been added to configure the OEM specific interface. The full CLI interface may be accessed either via:

The debug serial port

A standard TELNET connection on port 23

The debug serial port will generate unsolicited messages reporting system behaviour. The exact messages generated will depend on various system configuration, logging and debug options. We therefore recommend that access to this port be available during the trial for system configuration and for system software maintenance.

The serial port operates as a 3-wire connection, 19200bps, 8data, 1stop, XON/XOFF protocol.

The TELNET interface will time out on no input, closing the connection. The actual timeout period may be configured.

Command		Notes
`lcc show`		Show current lcc specific configuration options
`lcc set`		Set a specific lcc configuration parameter
	`host`	Set IP address of lcc host system
	`account`	Set account name used by lcc software to transfer data to host system
	`password`	Set the password for the above account
	`separator`	Set the separator used to separate field in lcc specific log files and file names. By default this will be *comma* making the files *CSV* format
	`device`	Set the storage device used on the P372 to store log files. By default this will be mem:/ However if a hard disk is available this coulfd be changed to dos:/ allowing for larger logfiles
	`name`	Set the root file name used for log file names on the P372. By default this will be LCC.
	`host_path`	Set the path used from the FTP account home directory on the host system on to which the log files will be placed
	`size nnnn`	Set the maximum size a log file will be allowed to reach before it is queued for transfer to the host system. Where nnnn is the maximum size of the file in bytes.
	`count nnnn`	Set the number of plate records covered by one log file (this parameter is ignored if set to 0)
	`time`	Set the time interval one log file will be used before it is closed and queued for transfer to the host system. Where nnn is the number of minutes for which a log file is active. (this parameter is ignored if set to 0)
	`debug`	Set to non zero to enable debug messages
	`threshold`	Set the ALPR confidence threshold below which licence plate reads will not be accepted by the system
	`nlog`	Set the number of temporary log files the P372 will maintain in a queue for transfer to the host system
	`image`	If set to 0, no image will be transferred to the host system. If set to 1 JPEG images will be transferred to the host system for each licence plate detected. Refer to the JPEG configuration options for details.

In the suggested configuration, when the P372 detects a licence plate, the number will be read and an entry will be placed in a log file within the P372. Optionally a JPEG compressed copy of the plate patch image will be transferred to the host system. The log file will grow until the first of three possible limits is reached:

Limit	Description
Size	If the log file exceeds the configured size (lcc set size nnn)
Count	If the count of plates processed (lcc set count nnn)
Time	If the current log file has been running for the given number of minutes (lcc set time nnn). NB: the count is not started from system start, but rather runs until the time is a multiple of the given count eg if count were set to 60, then data would be transferred on every hour.

When the limit is reached, the log file is renamed, and a new log file is created. The renamed log file is then queued for transfer via ftp to the host system. It is possible for a number of log files to be waiting for transfer to the host system. This might happen if for example the connection to the host system is lost as the PC is restarted. The exact number of files waiting cannot exceed that in parameter nlog. Should the system need to create a new file when this number has been reached, then the oldest file will be deleted.

In the default configuration described here, all files are stored within a small ram storage drive. It is important to ensure that the worst case storage requirements will not exceed the available ram drive space. The ram drive space is 2 Mbyte. If parameter nlog is set to 4 then the maximum size should be set to no more than about 150000. This will allow enough space for 4 files in the queue, one active file, plus storage for other necessary files.

Each plate record is about 30 bytes, so 150000 would represent about 5000 vehicles.

A example configuration would be to set size to 150000 to provide a size safety limit, then set time to 60. This would result in a new log file appearing on the host system every hour.

4.5 Data Format

The OEM specific software provides two data streams. One stream is the log of all plates detected and read. The other and optional data stream is a JPEG compressed patch showing a picture of each licence plate.

4.5.1 Log Files

As described above the P372 generates a log file with a record for each licence plate detected and read. Log files are created within the P372 and transferred on either time or size overflow. The P372 is not limited to providing batch transfers, but could transfer the data in real time to a suitable accepting application if this were available and appropriate.

Each record has the format:

mmdd,hhmmsst,n,PPPPP,cc

where:

mm	month
dd	day
hh	hour
mm	minute
ss	second
t	tenth second
n	camera number (0-3)
PPPP	licence plate
cc	% confidence in read

eg

0329,1455108,0,W202MAK,94

would indicate:

29 March, 14:55 pm 10.8 seconds

image collected from camera 1

Plate: W202MAK read with confidence 94%

With the default field separator of comma these records form a CSV format file which may easily be imported into many data processing applications.

When a log file is transferred to the host system it will have a name giving the time stamp of the first record in the file. eg a log file might have the name:

0329,1455099.csv

Would indicate that the first record in this log file was captured on 29 March at 14:55pm 9.9 seconds. The file name extension is set to CSV so that it is readily identified by processing applications such as MS EXCEL.

4.5.2 Patch Files

The P372 can optionally transfer plate patch files to the host PC if required. This is enabled with configuration option lcc set image 1. There are a number of configuration options used to manage the transfer of these images. As there are potentially very many of these image files the P372 will break the storage of the images into a number of separate directories with a configurable maximum number of files in each directory. Each image file is given a name based on the same format as the log file record:

eg:

p0329,1221465,0,W202MAK,96.jpg

The prefix p indicates that this is a patch file.

4.5.3 File Locations

If the suggested PC configuration is followed then the files will appear in a directory tree as illustrated below:

D:\inetpub\ftproot\lcc_test

```
├────J00000
|           p0329,1255118,2,S773RLD,90.jpg
|           p0329,1255162,0,W782PJB,66.jpg
|           p0329,1255181,0,R453ORW,94.jpg
|           p0330,7802339,0,T875MAB,98.jpg
|           . . .
├────J00001
|           p0329,1529510,0,R823KDB,98.jpg
|           p0329,1529510,2,R823KDB,98.jpg
|           p0329,1529524,2,L36RFL,82.jpg
|           p0329,1529537,0,D258HBP,94.jpg
|           . . .
└────log
            0329,1220127.csv
            0329,1225037.csv
            0329,1230045.csv
            0329,1244598.csv
            0329,1300034.csv
            0329,1455099.csv
            0329,1529154.csv
```

4.6 Time Synchronisation

The P372 system will attempt to maintain local time and date via a connection to the BSD / UNIX style SNTP (preferred) or daytime server on a specified host machine at port 13. Most UNIX and NT systems will provide this service or can load a service to do so. This service call may be disabled by setting the time service host IP address to 0. If this service is disabled, then the 372 internal clock / calendar will drift with respect to external time. Note that event log message timestamps are also taken from the calendar.

4.7 PC Configuration

This section describes the configuration required for host PC running MS Windows2000 sp4. However it should be understood that the host system could run any operating system which runs TCP/IP protocols and supports FTP. Further, one host system will support many 372 ALPR camera units since all the host is providing is a repository for the results.

For demonstration and test purposes PIPS Technology have suggested that the host server is configured to run the MS FTP server. You will need to allocate a directory with adequate space to the FTP server. This directory should be on a NTFS partition.

The ftp server will need a suitable account configured. The P372 needs to know the account name and password. The name should be short (<10 characters), lower case, and containing no punctuation.

The ftp server should be set up to accept this account for UNIX mode file read and write. If you do not wish to use the ftp default directory for file storage then you will need to specify the desired directory as an alias directory for this account.

In addition you may need to change the software or configuration files on the P372. To do this you will need to add a further account to the PC system:

account name: ftp_boot

password: ftp_boot

This account should have at least read permission in the ftp default directory (\inetpub\ftproot). For a test system it might also be useful to have write permission granted as well. The ftp server must accept this account.

ftp timeouts should be set to 120 seconds.

4.8 System Connection

This describes the connection of one P372 system for trial purposes

4.8.1 Initial Connection

Connect a serial debug lead between the PC and the serial debug connector on the P372 breakout box. Configure a terminal emulator on the development PC to run 19200bps, 8 data, 1 stop, XON/XOFF protocol. We use KEAterm as this has many useful features. However hyperterm distributed with windows is adequate.

Connect power to the P372

Turn on the P372.

4.8.2 Network Configuration

Connect the P372 to your network hub via a normal 100/10baseT cable (not provided). Plugging it into the RJ45 connector on the breakout box.

Ensure that your development PC has TCP/IP configured. You will need to know the IP address of the PC.

Ensure that the development PC has a FTP server operating. The P372 will require this server at the very minimum to down load configuration scripts and any software updates. You may also configure the P372 to save images via the ftp server. You will need to

ensure that the FTP system recognises at least one account for both read and write. This account will have:

account name: ftp_boot

password: ftp_boot

You will need to know the default directory for this account.

The following table shows the address map I am running, so that the examples below may be understood:

Machine	My Address	Your Address
trial PC	195.40.28.131	
1st P372	195.40.28.139	
SNTP server	195.40.28.131	
jpeg server	195.40.28.131	

If you wish to use a network time server ensure that your network has an SNTP server running. You will need to know the IP address of this server.

Allocate IP addresses for the P372 units within your local domain. The P372 defaults to a mask of 255.255.255.0

Turn on the P372. When the chevron prompt appears, configure the network addresses within the P372:

the P372s own IP address:

```
>>set internet 195.40.28.139
system serial number: 13
ethernet hardware address: 0800 372b 0013
internet address: 195.40.28.139
server address: 195.40.28.131
>>
```

the P372s default FTP server:

```
>>set server 195.40.28.131
system serial number: 13
ethernet hardware address: 0800 372b 0013
internet address: 195.40.28.139
server address: 195.40.28.131
>>
```

You will need to reset the P372 for these changes to take effect

```
>> reset
```

Once the system has returned to the chevron prompt, test that the network connections are operating.

test the link to the host PC:

```
>>ping 195.40.28.131
PING 195.40.28.131 (195.40.28.131): 56 data bytes
64 bytes from 195.40.28.131: icmp_seq=0 ttl=128 time=2 ms
64 bytes from 195.40.28.131: icmp_seq=1 ttl=128 time=1 ms
64 bytes from 195.40.28.131: icmp_seq=2 ttl=128 time=1 ms
```

```
64 bytes from 195.40.28.131: icmp_seq=3 ttl=128 time=1 ms


--- 195.40.28.131 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1/1/2 ms
>>
```

Unpack the zip file containing configuration scripts into the directory on the development system for account ftp_boot. Confirm that the ftp client on the P372 can "see" this directory:

```
>>ftp dir
----------   1 owner    group            2562 Mar  2 17:50 lcccnf01.scr
----------   1 owner    group             150 Mar  3 12:33 lccupd.scr
>>
```

You may have other files, depending upon the exact files shipped.

If you have troubles with the ftp connection you can turn on debug messages for the ftp client:

```
>> sys set ftp_debug 0xff
```

You will now see reports indicating the stages of the connection. As an example, on my machine I request ftp transfer of file *seq* from the P372 to the PC:

```
>>sys set ftp_debug 0xff
>>ftp put seq
220 gawpc Microsoft FTP Service (Version 3.0).
user ftp_boot
331 Password required for ftp_boot.
pass ftp_boot
230-GAWPC ftp server
230 User ftp_boot logged in.
type I
200 Type set to I.
pasv
227 Entering Passive Mode (195,40,28,131,4,70).
stor seq
125 Data connection already open; Transfer starting.
226 Transfer complete.
seq copied
quit
221
>>sys set ftp_debug 0
>>
```

Running the same example with write permission removed at the PC gives:

```
>>sys set ftp_debug 0xff
>>ftp put seq
220 gawpc Microsoft FTP Service (Version 3.0).
```

```
user ftp_boot
331 Password required for ftp_boot.
pass ftp_boot
230-GAWPC ftp server
230 User ftp_boot logged in.
type I
200 Type set to I.
pasv
227 Entering Passive Mode (195,40,28,131,4,72).
stor seq
550 seq: Access is denied.
quit
221
>>sys set ftp_debug 0
>>
```

Ensure that once the connection is ok you disable debug on the ftp connection as shown at the end of the above examples. The debug messages can lead to connection disruption.

Appendix 5 OEM Journey Time System

5.1 Journey Time System Specific Configuration

This document describes the additional facilities provided as part of the TCP/IP network based OEM journey time system.

A set of dedicated CLI options have been added to configure the journey time specific interface. The full CLI interface may be access either via:

- The debug serial port
- A standard TELNET connection on port 23

The debug serial port will generate unsolicited messages reporting system behaviour. The exact messages generated will depend on various system configuration, logging and debug options. We therefore recommend that access be available for system configuration and for system software maintenance.

The serial port uses a 3-wire connection, 19200bps, 8data, 1stop, XON/XOFF protocol.

The TELNET interface will time out on no input, closing the connection. The actual timeout period may be configured.

Command		Notes
`ojt show`		Show current ojt specific configuration options
`ojt set`		Set a specific ojt configuration parameter
	`jt_host aaa.bbb.ccc.ddd`	Set IP address of ojt journey time host system
	`hb_host aaa.bbb.ccc.ddd`	Set IP address of ojt heart beat host system (heartbeat may be turned off by setting this address to 0)
	`station`	Unique station identification string. This may be any alphanumeric up to 8 characters, but should not contain space or punctuation.
	`jt_port`	Set the port number for the process receiving vehicle tag information
	`hb_port`	Set the port number for the process expecting heart beat messages
	`keep_alive`	Period in seconds between heart beat messages. Also. the journey time connection will close is no data is sent for half of this period. If set to 0: no heart beat messages will be sent and the journey time connection will close after 20 seconds .
	`not_alive`	If the heart beat process is running (i.e. keep_alive > 0) then if the heart beat fails to send its message (i.e. unable to establish connection) for this many attempts, then the 372 will attempt recovery action.
	`timeout`	If no plate image is received on a camera for this number of seconds then a bit will be set in the status register. This may indicate a possible system failure e.g. camera fault or, may indicate that a lane is closed.

Cont/

Command		Notes
ojt set	debug 0xnn	Set to non zero to turn on ojt specific debug messages 0x01 - tag message reports 0x02 - heartbeat message reports
	hash	Set plate hash function modes 0x00 – plate is forwarded unchanged 0x01 – reduce ambiguous characters

5.2 Vehicle Tag Message

On detection of a vehicle. the P372 will send a message to the host system comprising time stamp and tag details. The connection to the host is opened on the first plate and thereafter maintained open until no vehicles have been detected for a period, at which time the connection will be closed. The period will be half of keep_alive, or if this is set to 0 then will default to 20s. On transmission failure (e.g. lost connection) the P372 will retry the connection and transmission.

5.2.1 Format of Tag Message

Each number plate record will comprise:

- time stamp
- station identifier
- Camera channel
- ALPR plate string
- Confidence factor

The record will be comma delimited and terminated by newline.

`yyyy-mm-dd:hh:mm:ss:aa,SSSS,n,ttttt,cc`

where

yyyy	Year
mm	Month
dd	Day
hh	Hour
mm	Minutes
ss	Seconds
aa	1/100 seconds
SSSS	Station identifier string as entered in configuration
n	Camera number
ttttt	Vehicle tag – exact length will depend upon plate format.
cc	Read confidence 0 - 99

5.3 Heart Beat Message

If option keep_alive is set to non zero, then, on every "keep_alive" seconds the P372 will open a connection to the host system and send a heart beat message. The connection will be closed after transmission.

Heart beat may also be disabled by setting the heartbeat host address to 0. This may be required if keep_alive is set non zero to maintain the tag link for a period other than 20 seconds.

5.3.1 Format of Heart Beat Message

```
iiii,ssss,bbb,f\n
```

where:

`iiii`	Station identifier – this can be any string of letters and numbers up to eight characters in length. The string should not include punctuation
`ssss`	Station status – a hex number. 0 is OK, any non zero value indicates a potential system problem. The exact format of this is described below.
`bbb`	Beat number - decimal number. wraps at 999. The receiving system may check sequencing to detect any network or system problems.
`f`	Decimal number of failures to send heart beat. This will reset to zero on a successful send. If this is ever non zero it may indicate a network problem.

example 1234,0,876,0

which would indicate

- station 1234
- status of station is 0 which is OK
- 876 heart beat messages have been sent
- no heart beat failures since the last successful send

If variable not_alive is set non zero, when the number of sequential failures to transmit the heartbeat reaches this number, then the system will attempt recovery action. The most likely outcome will be a forced system reset.

5.3.2 Heart Beat Status Report

The status report in the heart beat message will return 0 for all ok and non zero for any possible system problem which has been detected internally. One or more of the following bits might be set indicating internal system status:

`0x0001`	Last heartbeat connection failed
`0x0002`	Last time update request failed
`0x0004`	Tag report link to host is closed (this is possibly a “normal” condition if there is little traffic)
`0x0008`	Not used
`0x0010`	Time out on vehicle detection for camera 1
`0x0020`	Time out on vehicle detection for camera 2 (only active if ch1 mux is on)
`0x0040`	Time out on vehicle detection for camera 3
`0x0080`	Time out on vehicle detection for camera 4 (only active if ch2 mux is on)
`0x0100`	P372 system has restarted. This is the first successful heartbeat transmission since startup. This bit would be cleared on subsequent transmissions.

5.4 Time Synchronisation

This application requires that the tags captured by a P372 be matched with events detected by other P372 systems. This is managed by time stamping captured images. These time stamps may then be compared to estimate journey time between capture. For this to work the two systems must share a common clock.

The P372 system will attempt to maintain local time and date via a connection to the BSD / UNIX style SNTP (preferred) or daytime server on a specified host machine at port 13. Most Unix and NT systems will provide this service or can load a service to do so. This service call may be disabled by setting the time service host IP address to 0. If this service is disabled, then the 372 internal clock / calendar will drift with respect to external time. Note also that event log message timestamps are taken from the calendar.

A modification has been added to the daytime server to enable transfer of time information to a higher resolution. An example of the normal daytime string is:

Thu May 10 10:18:06 2001

The P372 software will parse this as normal. However the P372 will look for an extra parameter at the end of the string:

Thu May 10 10:18:06 2001 33

This parameter is the sub second time, measured in units of 0.01 seconds. This modification permits normal daytime servers to be used unchanged. However a specific daytime server may be written to provide this extra sub-second information. The normal daytime server responds on port 13. If a non-standard daytime server is incorporated into the host system then it should be assigned a proprietary port number.

Appendix 6 P372 Application Notes

This section reviews a number of example configurations, showing how the P372 might be used to solve typical problems. These examples are shown as case studies. The software and functionality described may not be available as standard on the P372. It is usually the case that a specific application or configuration will require specific software to be implemented. These case studies show how that might be done by describing the required system configuration and hypothetical software specification. Each of these case studies are based on actual systems and software installed by PIPS Technology.

6.1 Tolling System

The customer is implementing a free flowing road tolling operation. Vehicles contain transponders. When a vehicle passes through the tolling plaza the transponder is interrogated and a charge made against the customers account. There are no barriers at the plaza in the automatic lanes. Therefore a system is required to identify violators. Road loops are used to detect vehicles passing the tolling point and trigger the transponder system. In order to provide adequate enforcement the customer requires:

- An overview of the road showing as much of the offending vehicle as possible. This image should be in colour.
- A patch image of the vehicle licence plate.
- An ALPR read of the vehicle licence plate.

PIPS Technology P372 ALPR cameras are mounted on a gantry to view the road at the position of the road loop. The colour overview camera will give a 3/4 view of the loop area. These cameras have wide angle lenses. Automatic switch on illumination is provided for night operation.

As traffic is running at high speed through the plaza, one P372 is required for each pair of lanes.

The P372 equipment is connected to the tolling equipment via Ethernet and TCP/IP protocols.

The tolling loop trigger is connected to the external trigger input on the P372.

When a vehicle passes through the plaza the loop trigger causes the P372 to initiate a capture sequence. The P372 ALPR system will observe the vehicle for a (configurable) period of time usually 80-200ms. The P372 will save the best licence plate image captured during this period together with the first captured overview image from the colour camera. Each of these images will be time stamped. The image set is stored in a circular buffer within the P372.

Should the vehicle be a violator, the tolling system will send a message to the P372 indicating the time at which the vehicle entered the loop. The P372 will match this time with an image set within its internal buffer and forward the image set to the tolling system. Should no request be made for an image set within a (configurable) period, typically 10 seconds, the image set is discarded.

The image sets are forwarded to tolling system by means of the ftp protocol. The tolling host system runs an ftp server. The P372 opens a connection and transfers the required image set. On completion of an image set transfer the P372 sends a message via a separate channel to indicate that the transmission is complete.

6.1.1 File Formats

The overview image is a colour JPEG image. The vehicle plate image may either be BMP format or JPEG format. Image files are identified by their name ie

SCmmsstt,LLLLL,G.ext

where

S	image source: w for wideangle, p for plate patch
C	camera (a,b,c.d)
mm	minutes
ss	seconds
tt	ticks
LLLL	vehicle licence plate tag
G	confidence of licence plate read
ext	extension indicating image type (jpg or bmp)

6.1.2 Time Stamps

This application requires that the images captured by the 372 be matched with events detected by the main tolling system. This is managed by time stamping captured images. These time stamps may then be compared with the known tolling event time to select the correct image set for transfer. For this to work the two systems must share a common clock.

In this application the customer decided that the common clock would run for 60 Minutes in 10 ms increments. The P372 runs an internal ms counter. To generate the P372 variant of this clock this internal counter is taken %(60 * 60 * 1000). This is synchronised to the tolling system by adding an offset computed from the time as returned from the tolling system. At P372 system start the internal counter will start at zero, and the offset will be zero. Therefore the two clocks are unlikely to be in sync until after the first time update.

The host system will provide a TCP/IP server listening on a defined port. Upon receiving a connection it will return a simple text string indicating host system current time then close the connection. The actual server address and port are configurable.

The time message will be in the format

mm ss tt

where

mm	minutes
ss	seconds
tt	ticks (1/100 second)

As it is captured images that are time stamped, the actual images selected will never have the exact time stamp of the tolling event, but will be delayed as the video system runs asynchronously at normal video rates. An exposure sequence is usually four fields. By default, the image set time stamp is that of the overview image. As the exposure sequence is asynchronous to the triggered input, latency between a trigger event and the capture of an overview image will be less than four fields (<100ms Europe, <80ms USA) .Thus when requesting an image set, a time window may be specified within which an image will be accepted.

An alternative mechanism would be to use a standard calendar timestamp eg the minutes, seconds, ticks from a normal clock.

The P372 system will maintain local time and date via a connection to the BSD / UNIX style SNTP (preferred) or daytime server on a specified host machine at port 13. Most Unix and NT systems will provide this service or can load a service to do so. This service call may be disabled by setting the time service host IP address to 0. If this service is disabled, then the P372 internal calendar will drift with respect to external time. Event log message timestamps are taken from the calendar.

6.1.3 Command Channel

The tolling host system opens a connection to the P372 to issue requests for image sets or for system status. The connection is a network virtual terminal (NVT) ie a telnet like connection, but without any handshake to manage echo and line edit configuration. The connection port used is a configurable parameter. Each command issued on this connection is a simple test string terminated with newline. The connection will be closed automatically after a configurable period without any commands.

Command		Notes
find	l mm ss tt {www}	find and forward a stored image set for lane l at time mmsstt within window www ms. If window parameter is not given then the configurable default will be used. The successful reply to this command will be: OK l mm ss tt MM SS TT npwm where l - lane (a-d) mm ss tt - requested time stamp MM SS TT - matched time stamp npwm - n - normal front view p - plate patch w - colour wide angle m - monochrome wide angle missing images replaced by underscore
trigger	l	Simulate a trigger on lane l - valid lanes a-d. This mechanism may be used to force the system to grab a wide angle image. Once this command is issued, the 372 will behave as though a trigger event had occurred on the relevant camera trigger input.
list		List content of store buffer. The list shown will be in the form: s l mmsstt s – slot l – lane (a-d) mm – minutes ss – seconds tt – ticks
status		Indicates: Current status of the ftp link to the host system, Last link error if any. Current consumption of each camera channel.
reset		Force the 372 to perform a complete software reset. All current IP connections will be lost, and all current image sets will be discarded.
logout		Close the connection, wait for a new connection

6.1.4 Message Channel

A message channel is available, providing progress and status messages for the file transfer operations. This message channel appears on a separate configurable TCP/IP port. There will be no effect on system behaviour if the port is left unconnected. Messages will be strictly formatted to facilitate machine reading. Messages will:

be ASCII text

be newline terminated

start with a message specific identifier of the form:

Lnnn

where L is an upper case letter , one of:

M progress message

W warning message

E error message

P panic message

nnn is a unique numeric message identifier

eg

```
P123 PANIC @ 0x123abcd  widget failed
```

This is an extensible system. In practise the only messages implemented for this application are:

`M000 n keep alive`	Keep alive message transmitted every 30 seconds. n is a decimal numeral incrementing on every transmission
`M001 filespec`	Indicates that transmission of filespec is complete
`M002 l mmsstt npwm`	Indicates that transmission of image set for lane l at timestamp mmsstt containing images npwm is complete

example messages from the message channel

```
M000 482 keep alive
M001 wc451556.jpg
M002 c 451556 __w_
M001 wa451568.jpg
M002 a 451568 __w_
M001 pc451808.jpg
M001 wc451808.jpg
M002 c 451808 npw_
```

6.1.5 Keep Alive

It is desirable that in the event of any system failure, the system should as far as is possible perform automatic recovery, whether that failure be internal or external to the P372.

As part of this mechanism, the time client process may act as a "keep alive" monitor. If no replies have been received for a configurable time, then the system will restart.

In addition, the message channel will transmit a periodic message if no other messages have been sent for the configurable period msg_timeout seconds . The host system may use the presence of data on this service as an indication that the P372 is operational.

6.1.6 Error Codes

The tolling specific CLI interface returns either OK or ERR nn on completion of any command.

Error Code	Command	Reason
00	n/a	command not recognised
01	set	parameter not matched
10	time	incorrect number of parameters
11	time	range error – minutes
12	time	range error – seconds
13	time	range error – ticks
20	find	incorrect number of parameters
21	find	range error – minutes
22	find	range error – seconds
23	find	range error – ticks
24	find	range error – camera number
25	find	no matching image set found
30	list	no images in store
40	trigger	missing camera parameter
41	trigger	camera is not in valid range

6.1.7 Status Report

The status request will always return OK. Exact status of system is conveyed via subsequent parameters in the reply message.

OK nvt:n ftp:n msg:n clk:n

where:

n is state of communication channel

eg:

OK nvt:6 ftp:1 msg:6 clk:1 I:6,12,1,1

nvt channel state : 6

ftp channel state: 1

msg channel state: 6

clock state: 1

6.1.8 Tolling Specific Configuration Options

The tolling system has a number of application specific configuration options in addition to those described in the main configuration notes.

Command		Notes
Host		Set host ftp server IP address
Account		Host ftp server account name
Password		Host ftp server password
sim_host		Set simulation ftp server IP address
sim_account		Simulation ftp server account name
sim_password		Simulation ftp server password
ftp_timeout		Period in seconds ftp connection will remain open with no data to transfer
nvt_port		Set the local TCP/IP port used by nvt command channel. A system restart will be required after this has been changed.
msg port		Set the local TCP/IP port used by the message channel. A system restart will be required after this has been changed.
time_host		Set host system IP address providing time services
time_port		Set the host system tcp port providing the proprietary time service. (0 disables client)
time_poll		Period in seconds between polls of host for time service (0 disables client);
keep_alive	nn	If no time service replies have been received for this number of polls, then the 372 will perform an automatic restart. 0 disables this facility.
debug	0x00	Debug all off
	0x10	Monitor nvt interface
	0x01	CLI interface functions, buffer functions
	0x08	Time system functions
	0x04	ftp states
	0x02	ftp timing
	0x20	Push processor
	0x40	Message channel
max_age		Age in seconds for which images are maintained in the history table. NB: images will be discarded oldest first despite this setting when the table becomes full.

Cont/

Command		Notes
window		default time window (ms) within which to match requested image
nvt_timeout		Tolling system control nvt will close after timeout seconds of inactivity
jpeg	0xnn	Ouput images may be windows BMP format or JPEG format. set bits in this parameter to define the format for each image. (use set jpeg quality nn to set the compression level)
	0x01	Set to save plate patch in jpeg format, clear to save in bmp format
	0x02	Set to save full plate image in JPEG format, clear to save in BMP format
	0x04	Set to save overview file in JPEG format, clear to save in BMP format
msg_timeout	nn	If no messages have been sent on the message channel for nn seconds, then a message M000 is sent.
simulate	0x0n	Set to force transfer of triggered images to the simulation ftp server. This option has been added to facilitate testing without access to the tolling control system. Images of all vehicles for which triggers have been generated will be copied to the ftp server. (see note 1)
	0x01	Transfer patch
	0x02	Transfer full plate image
	0x04	Transfer overview image

Note 1: Take care when using the simulation facility as all triggered images will be transferred to the simulation server. An image transfer can take up to two seconds. Frequent vehicle triggers could result in an overloaded system.

6.2 Security Monitoring System

The customer operates a secure site. The requirement is for a system to provide image and ALPR records of all vehicles entering the site. This system will run independently of the manual processing of vehicles as they enter or leave the site.

The site has barriers at entrances. Loops are available indicating when a vehicle is waiting at the barrier.

For each lane entering the site, one P372 camera is mounted on a pole viewing the area before the barrier.

A central system stores the images and vehicle tags in a database.

The P372 systems are coupled to the central system via Ethernet carried over fibre.

When a vehicle crosses the loop a trigger is forwarded to the P372. The P372 will observe the vehicle for a configurable period, typically 150-300ms. During this period, one overview and the best licence plate image will be saved.

6.3 Car Parking

The car park has two entry lanes and one exit lane. The latter has a payment booth. One of the entry lanes and the exit lane are to be monitored by automatic licence plate reading system (ALPR). Each of the lanes will be monitored by one P372 camera. This will feed data to the parking system.

Front or rear plates?

The site is located in the US, however there is a requirement to recognise plates from adjoining states. Initial information from a web site indicates two of these states do not require front plates thus the system must look at rear plates**.**

Location of capture point

In general the P372 camera can collect images suitable for ALPR with an image capture point at any distance between 12 feet and 60 feet from the camera. This distance does however have to be pre-selected, and the appropriate lens and illuminator fitted to the camera at the factory.

As rear plates are to be captured, the stopping point of the rear plate may vary considerably depending on the length of the vehicle (e.g. mobile homes, trailers, stretch-limos etc). It is important to decide the rear plate stopping point of the longest vehicle envisaged. The capture point must be at this point, or before. For many vehicles, the vehicle will stop with the plate not within the field of view. This means that for most vehicles, the plate will have to be read as the vehicle approaches the barrier, and the data stored until requested by the parking system.

The capture point also has to be located where the lateral position of the vehicle is constrained so that the licence plate will always pass through the field of view. Clearly the capture point must also be located where cameras can be practically mounted to have a clear field of view (see below)

Location of P372 relative to the capture point

Set against these points are the considerations of practical camera location, and minimising obscuration by following (or tailgating) vehicles.

In practice, many car park operators use a relatively short distance between the camera and capture point. Typically 12 to 30 feet. The camera is usually mounted over the lane or as close as possible to the side of the lane.

Other considerations

It is important that there are not any other retro reflective surfaces within the field of view. These could be fixed or moving barriers, an operative's coat, parked vehicles, signs etc.

Strong sunlight either directly in the field of view, or behind the camera in a direct line from the target through the camera are worth avoiding as even with the P372's ability to suppress sunlight, there may be a loss of data for certain times of the day.

If front plates are to be captured then usually it is necessary to have the camera in front of the barrier either looking above or below the barrier.

The mounting of the camera also needs consideration. Typically cameras in car parks are mounted within bollards, on posts or mounted from roofs or walls etc. Clearly they must be in a position such that they will not be hit by vehicles, and will not be too prone to vandalism.

Appendix 7 High Level Commands at the CLI Interface

These commands are entered at the command line interface (CLI) on the P372. The function of these commands is described in Appendix 3.

1 - capture

Available Commands are

0 - set

1 - show

2 – script

3 – clear

4 - stats

2 - dump

Available Commands are

0 - ram

1 - cpu

2 - eeprom

3 - line

4 – file

5 - script

3 - show

Available Commands are

0 - stack

1 - profile

2 – history

3 – queues

4 – files

5 - port

6 - date

7 - time

8 - triger

9 - serial

10 - bit

11 - boot

12 - config

13 - counters

14 - itab

15 - image

16 - analyse

17 - site

18 - jpeg

19 - raw
20 - capture
21 - log
22 - anpr
23 - system
24 - kermit
25 - carpark
26 - client
27 - tl
28 - sync

4 - set

Available Commands are

0 - date
1 - inter
2 - server
3 - serial
4 - ether
5 - boot
6 - password
7 - itab
8 - cam
9 - mode
10 - thresh
11 - width
12 - trigger
13 - cache
14 - config
15 - site
16 - route
17 - capture
18 - jpeg
19 - raw
20 - log
21 - anpr
22 - system
23 - kermit
24 - carpark
25 - client
26 - tl
27 - sync

5 - clear

Available Commands are

0 - image

1 - analyse

6 - help

7 - install

8 - test

Available Commands are

0 - text

1 - read

2 - write

3 - many

4 - ini

5 - uart

6 - seive

7 - whet

8 - dhry

9 – dma

10 – copy

11 – match

12 – sntp

13 – cc

14 - cam

9 - kermit

Available Commands are

0 - receive

1 - server

2 - send

3 - set

4 – show

5 - script

10 - ftp

Available Commands are

0 - nlist

1 - dir

2 - ls

3 - get

4 - put

5 - mput

6 - append

7 - mkdir

8 - md

9 - rmdir

10 - rd

11 - del

12 - rm

13 – rename

14 – user

15 - password

11 - pdb

Available Commands are

0 - set

1 – show

2 - script

3 - load

4 - lookup

5 - ammend

6 - insert

7 - delete

8 - clear

9 - save

12 - reset

13 - shutdown

14 - exit

15 - flash

Available Commands are

0 - write

1 - erase

16 - flex

Available Commands are

0 - load

1 – reset

2 - version

17 - fs

18 - snap

19 - jpeg

Available Commands are

0 - test

1 - set

2 - show

3 - script

21 - mail

Available Commands are

0 - send

1 - set

2 – show

3 - script

4 - queue

5 - release

22 - modem

Available Commands are

0 - test

1 - startl

2 - set

4 - show

5 – info

6 – hangup

7 – power

8 - command

23 - site

Available Commands are

0 - show

1 - set

24 - script

25 - system

Available Commands are

0 - set

1 - show

2 - script

26 - trigger

Available Commands are

0 - set

1 - show

2 – script

3 - count

4 - test

27 - log

Available Commands are

0 - set

1 - show

2 - script

3 - prepare

4 - delete

28 - bmp

Available Commands are

0 - test

1 - set

2 - show

3 - html

4 - ALPR

5 - list

6 - score

7 - script

29 - net

Available Commands are

0 - mask
1 - broadcast
2 - gateway
3 - set
4 - show
5 - config
6 - ping
7 - blast
8 - route
9 - getrt
10 - slip
11 – ppp
12 - info

30 - ping

32 - convert

Appendix 8 Customer Comment Proforma

This proforma should be retained in this publication. When required for use, reproduce (photocopy) locally.

To: **PIPS Technology Ltd**
York House
School Lane
Eastleigh
Hants SO53 4DG

From: **……**
……
……
……
……
Tel No…….

Senders Reference……

Date……..

Title of Publication: P372 Licence Plate Recognition Camera User Manual – Issue 2.1

USER COMMENT (Use a separate sheet of paper if necessary.)

Signed **Name**

To: **……**
……
……
……
……

From: **PIPS Technology Ltd**
York House
School Lane
Eastleigh
Hants SO53 4DG

Thank you for commenting on: P372 Licence Plate Recognition Camera User Manual – Issue 2.1

Action is being taken to:

*(1) Revise the publication
*(2) Amend the publication
*(3) No action is considered necessary for the following reasons:

* Delete as necessary

Signed **Name**