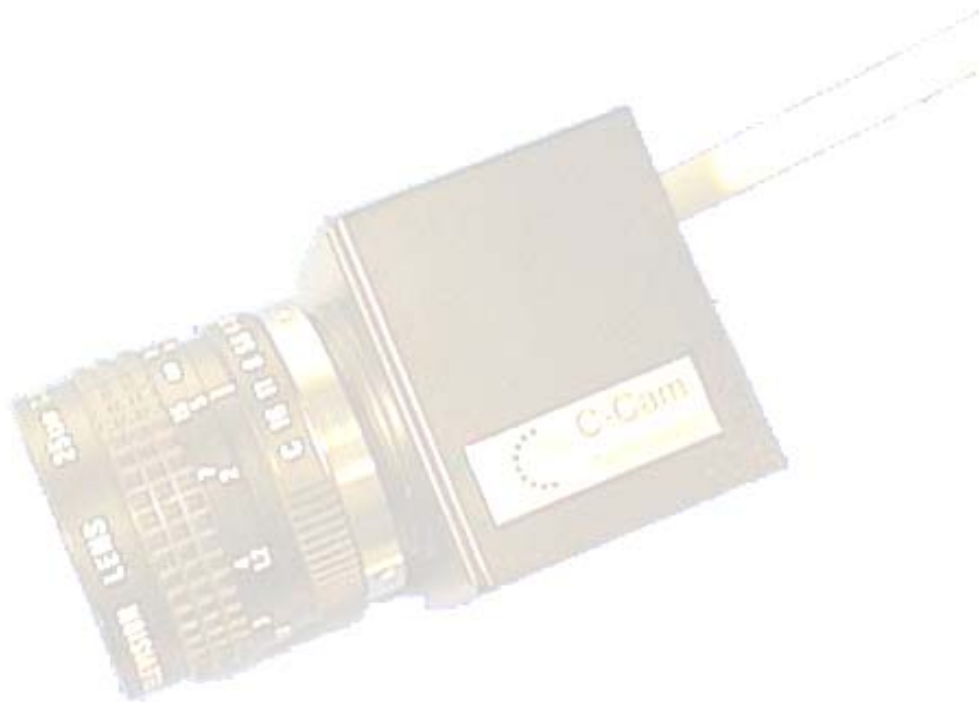# CT-Load

Camera Configuration Tool

A utility for the configuration and maintenance of C-Cam Technologies' C-MOS cameras with CameraLink Interface

file: CT-Load.doc
V2.1
30 April 2007

Table of Contents

Revision History

Revision	Date	Author	Description of changes
V2.1	30/04/2007	PmB	Specifying camera type Added protocol description

1 Introduction

The BC range of cameras contain an FPGA that can be programmed to perform camera control and local image processing functions. The FPGA configuration is volatile and must be loaded after applying power to the camera.

To save having to download this data each time the camera is used, the configuration file is held in a non-volatile SDF memory buffer in the camera and is transferred to the FPGA locally during the camera's power-up sequence.

The Camera Configuration Tool utility allows the user to communicate directly with the camera electronics and download a pre-compiled FPGA program, and other parameters, in preparation for use.

1.1 Terminology

uC of CPU	The heart of the BC electronics is the Philips 89LPC932 micro-controller.
SDF	2 Mb Serial Data Flash memory (Atmel)
FPGA	Altera Field-Programmable Gate-Array in the camera logic.
Records	(also referred to as "pages") Blocks of data sent to SDF memory
DLL	Dynamic Linked Library (e.g. CCAPI.DLL contains camera-related interface)

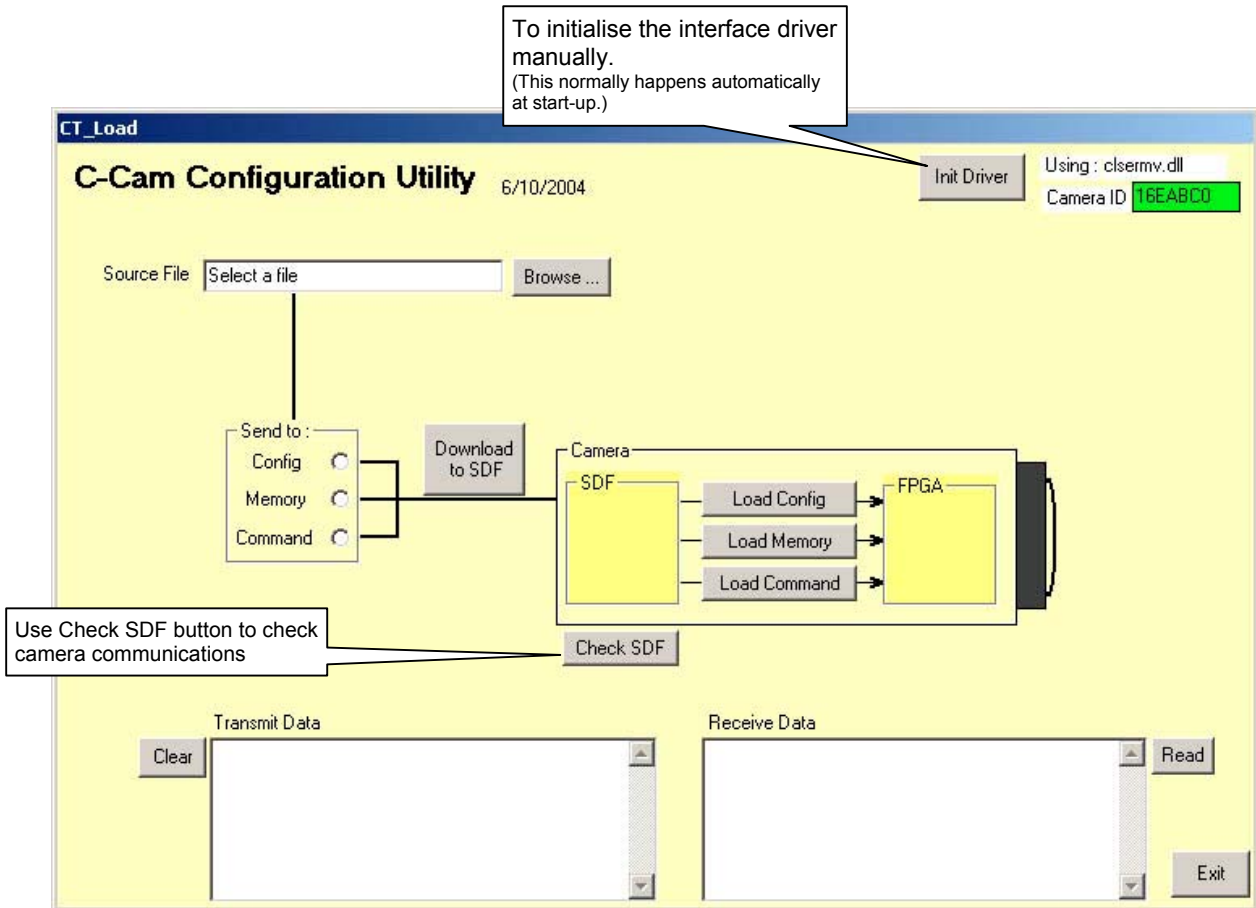## 1.2 Block Diagram
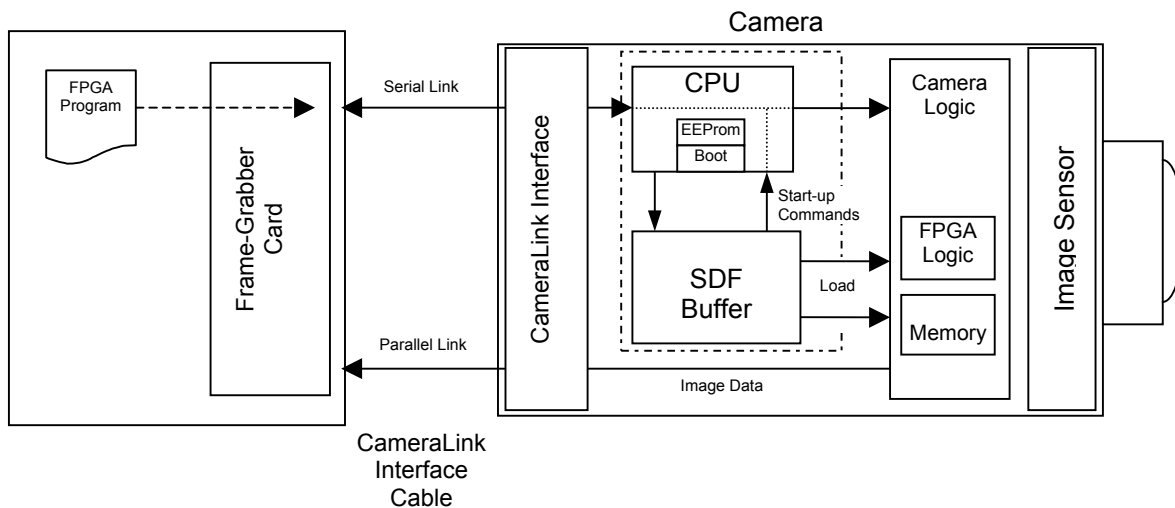
1.3 The Configuration Tool

This utility is written in Visual Basic and C++ and provides the user with a simple Graphics Interface (GUI) to perform the various tasks necessary in the preparation for use of the BC Camera.

The GUI communicates with a camera via the CameraLink serial interface. This communication channel requires some preparation before starting work.

2 Setting up the communication link

To initialise the interface driver manually.
(This normally happens automatically at start-up.)

CT_Load

C-Cam Configuration Utility 6/10/2004

Init Driver

Using : clsermv.dll
Camera ID 16EABC0

Source File Select a file   Browse ...

Send to :
Config ○
Memory ○
Command ○

Download to SDF

Camera
SDF

Load Config → FPGA
Load Memory →
Load Command →

Use Check SDF button to check camera communications

Check SDF

Transmit Data   Receive Data

Clear   Read

Exit

2.1 Steps to be performed at start-up:

a) The framegrabber must be installed and initialised, ready for use, before starting the Configuration Utility. Please refer to the manufacturer's documentation for this.

b) The manufacturer's driver for the CameraLink interface must be present in the Configuration Tool's directory. (In this example the manufacturer has supplied the driver: CLSERMV.DLL)

This is a DLL module supplied by the frame-grabber manufacturer using the standard naming convention:

clserxx.dll , where xx identifies the manufacturers name.
(e.g. clsermv.dll for the Matrix Vision frame-grabber)

This DLL provides the following standard calls to the CameraLink interface:
• clSerialInit
• clSerialRead
• clSerialWrite
• clSerialClose

c) If the initialisation file contains the line "AUTOSTART=1" then the link initialisation should occur automatically at start-up. Then the Camera ID should be GREEN, showing that initialisation of the Camera-Link interface has been completed successfully. (The ID number is for information only)

If the ID is NOT green then check that the correct DLL for the framegrabber is being used.
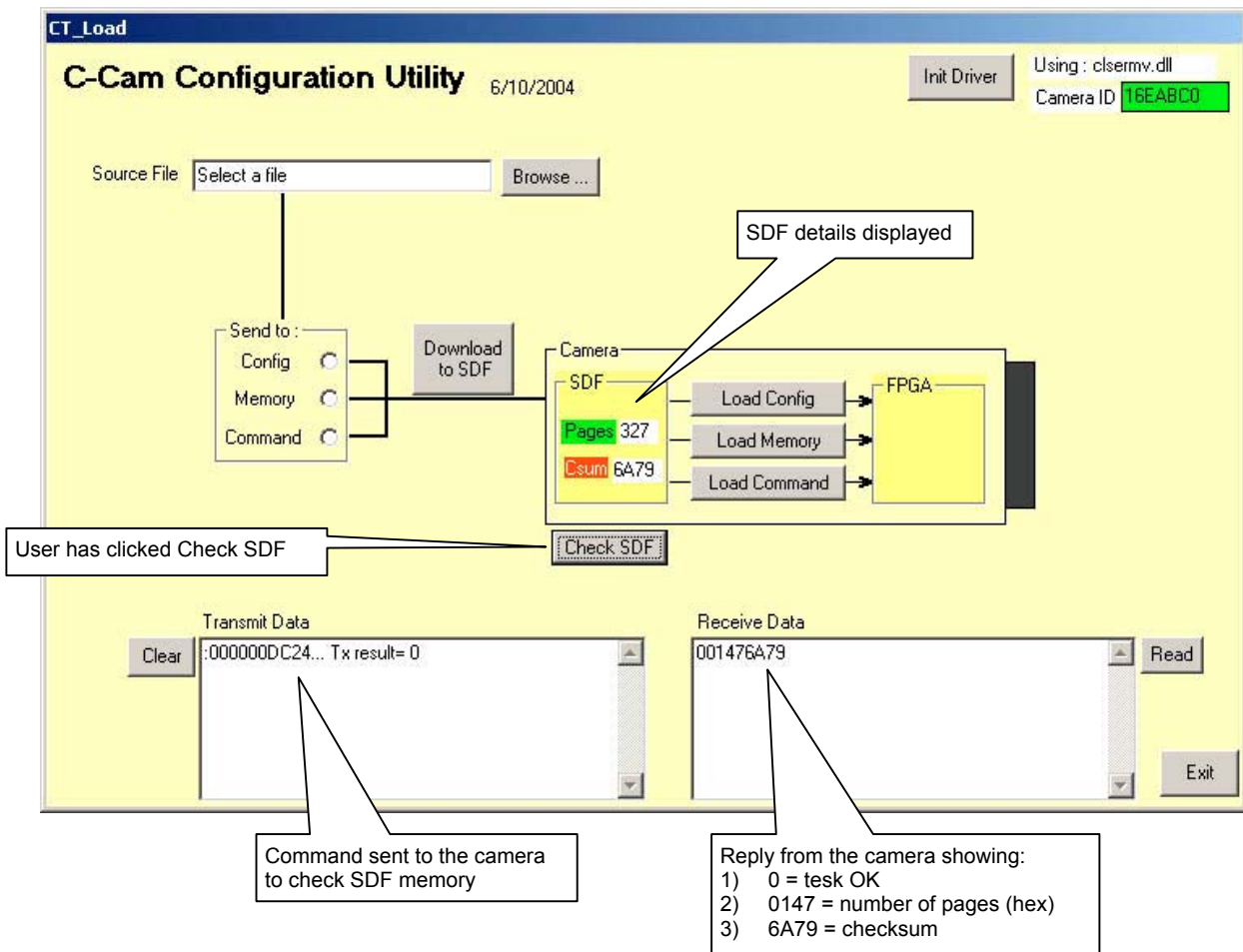(In this example .. Using: clsermv.dll)

To change the DLL: edit the file CTLOAD.INI

```
DLLNAME=clsermv.dll
….
…
```

2.2 Checking CameraLink communications

A simple way to check that communications are functioning correctly is by clicking the Check SDF button
This performs a test on the camera SDF memory and returns the number of pages stored and a global checksum across all pages.

Don't worry about the RED labels at the moment.

3 Download data to the camera

3.1 File Types

Use the Browse button to select a file to be downloaded to the camera
There are three types of file:

File type	Extension	Used for
Configuration data	.TTB	The "logic" program used by the FPGA
Memory data	.BIN	e.g. Image correction mask
Commands	.CMD	a "script" file containing commands to be executed by the camera automatically at start-up.

You can either:
- first select the type of file to be downloaded in the "*Send to*" box.
   The browse function will then show all files of this type.

Or
- first choose a file using the Browse button.
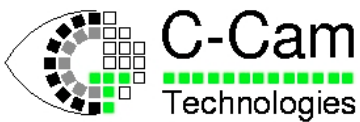   The "*Send to*" box will then show the correct download path.

When the file has been selected click the Download to SDF button and downloading will begin.
- The windows "*Transmit data*" and "*Receive data*" show the messages and responses.
- A progress bar and page counter show the download progress.
- A checksum is totalised during the download.

According to the size of the file being downloaded the transfer can take several minutes.
Transfer can be stopped by clicking on the Abort button.

3.2   After download

At the end of downloading configuration data the function "*Check SDF*" is performed to double-check that the page count and checksum data in the SDF correspond with the data sent.

At this point the labels "*Pages*" and "*Csum*" in the SDF box should be GREEN

For other file types the check can not be done.
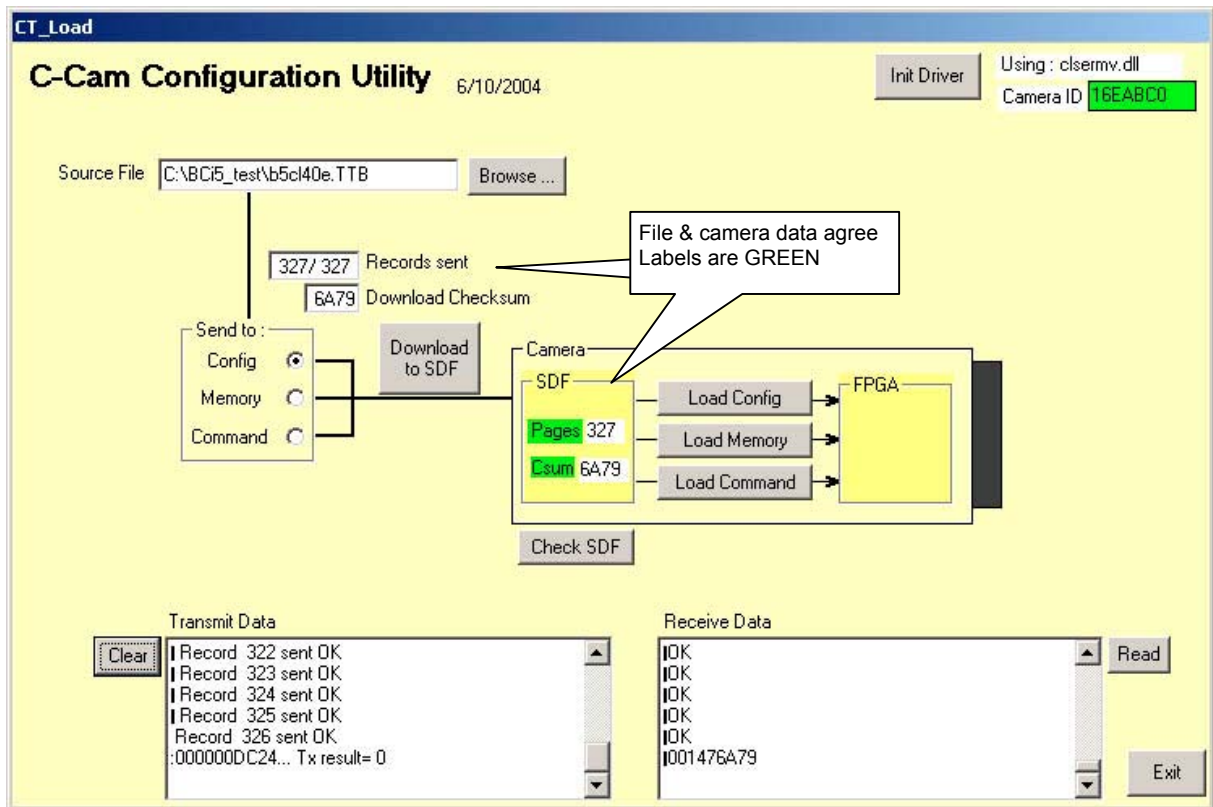
This process can be repeated for a Memory file and Command file, if desired.

Normally this data will be transferred from SDF to the FPGA the next time the camera is powered-up.

You can force this transfer to take place NOW by clicking on one of the "*Load …*" buttons inside the camera icon.

At the end of this process the camera is again ready for use.

4 Camera Commands

The CT-Load application software has been expanded to allow the user to issue commands directly to the camera.

4.1 How does it work?

To send a command to the camera the application makes use of the interface library CCAPI.

The high-level commands are sent to CCAPI which then returns the correct codes for sending to the camera in a command message. This process occurs transparently when a command button is clicked.

To generate the correct command codes for the type of camera being used we must specify the camera model in CTLOAD.INI
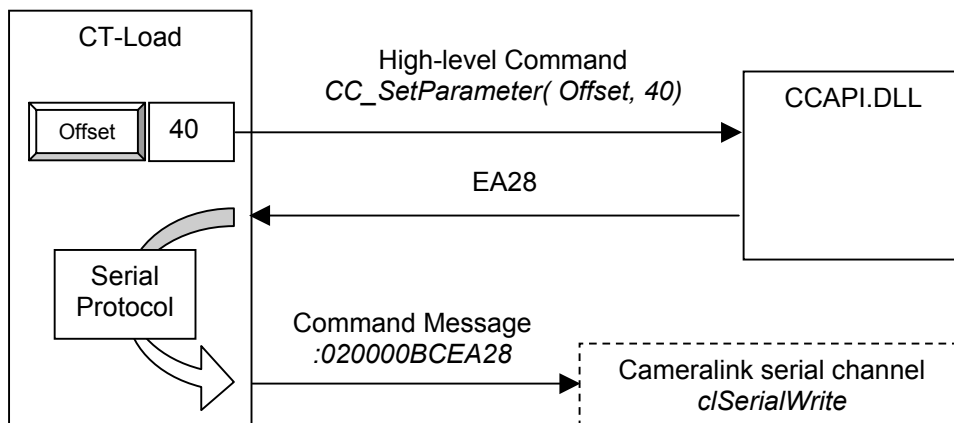
4.2 Specifying the camera type

As CCAPI is only intended for the USB and LS versions of the BC family of cameras we must use one of these as camera type:

     e.g. Type = BCi5 USB

Note: The definition "Type = BCi5 CL" will result in an error as CCAPI does not recognise this as a correct camera type.

5   Control Panel

The control panel provides windows for entering parameters and buttons to send these parameters to the camera.

2) Multi-slope commands are encoded via CCAPI

1) Click on Set to build multi-slope commands

Transmit Data   □ Hex

Clear
BCi5 LS
Level2 = 70
Level3 = 116
FFC3F200E300E23DE109E000EB00F201E300E2
0CE135E000E946F202E300E200E1EAE060E974

Receive Data   □ Parse   Read

Window-of-Interest
Start   Size
X (row) 0   1280
Y (col) 0   1024
Set

Camera
Auto   1   ms
Snap
Stop
Int.Time   100   us

Mode
○ Image
○ X-Diag
○ Y-Diag
○ XY-Diag

Link Width
● 8-bit
○ 12-bit

Set

V-Mid   220   mV
Core V   120   mV
Gain   0
Offset   40
" Fine   50

Multi-Slope
Int.Time uS   Volts   Single ○
Start   100000   4.0v   Multi ●
Knee 2   20000   3.7v
Knee 3   1500   3.5v   Set
Knee 4   1024   0

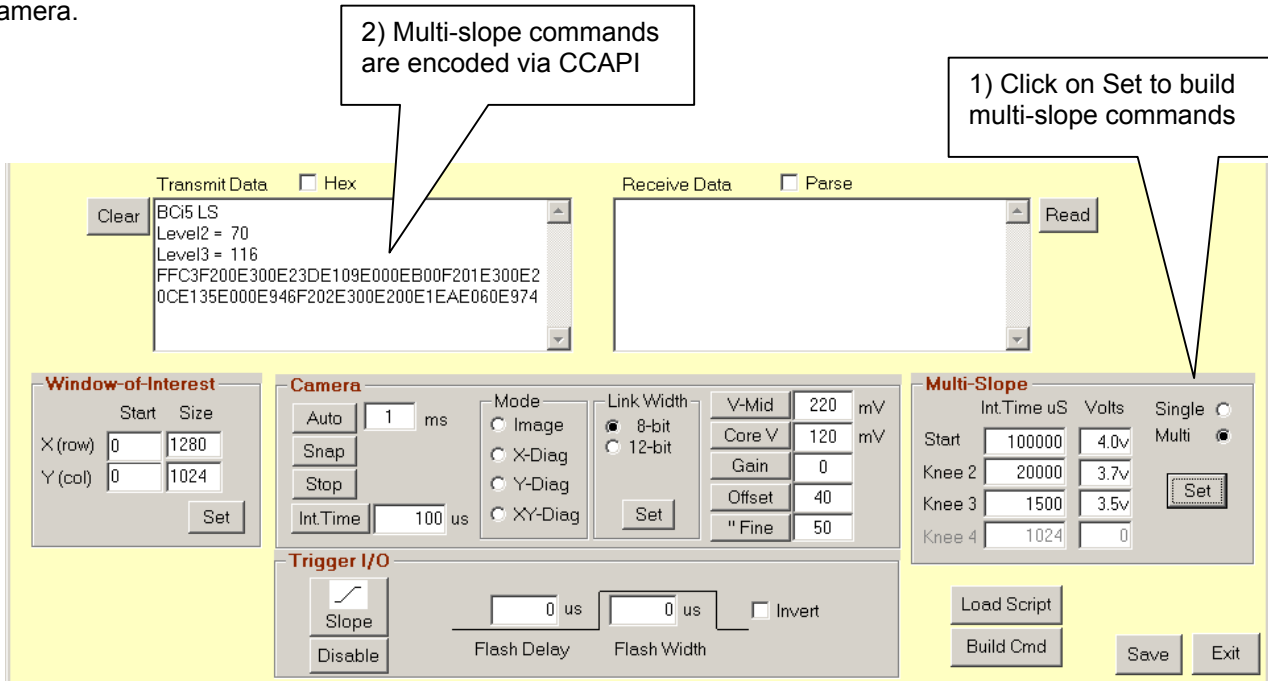**Trigger I/O**
Slope
Disable
0 us   0 us   □ Invert
Flash Delay   Flash Width

Load Script
Build Cmd
Save   Exit

Example of building commands for transmission to the camera

Window of Interest	Fill in the required dimensions of the WOI and click "Set" to transmit this to the camera. Of course the frame-grabber must be instructed to receive the new frame dimensions.
Auto	Transmits the frame time selected and starts the "Auto-Trigger" function of the camera. Frame times smaller than the transmission time will result in a contiuous stream of frames at the maximum possible rate.
Stop	Stops the "Auto-Trigger" function of the camera.
Snap	Causes one frame to be transmitted
Int.Time	Sets the integration time of the camera
V-Mid	(refer to the camera manual)
Core Voltage	(refer to the camera manual)
Gain	(refer to the camera manual)
Offset	(refer to the camera manual)
Multi-Slope	Choose integration time and reset (knee) voltage for each region Erase values to disable a region Knee settings may be a voltage (3.7v) of an integer value (116). Please refer to the camera manual for further details
Trigger I/O	Settings for external trigger/flash output

6   Special command buttons

6.1   Build Cmd

This button is used to divert or capture all screen commands to a file for later transmission to the camera. (see above for the transmission of command files)

Usage:
Click the "Build Cmd File" button once. The caption changes to "Build"
Click each camera command button in turn to send commands to the file.
Terminate the file with the "Auto" button, as this is needed to start the camera's acquisition sequence.
Click the "Build" button to terminate command capture.

On inspection of the CT-Load directory there are now two additional files:
a) CT-Load.txt – is a text file containing the 16-bit hexadecimal camera commands. Use this to verify the build process. For instance, the Auto button terminates the file with the command "FF82"
b) CT-Load.cmd – this is a binary file suitable for downloading to the camera as a command file.

6.2   Load Script

This function allows the user to write a "script" file using a text editor. The file, called Script.txt, contains 16-bit commands, in hexadecimal, one command per line.
Clicking the Script button will initiate the process of reading the text file and translating each command into a valid binary command for the camera. All commands are then transmitted to the camera.
At the same time the file Script.cmd is created, containing all the commands that have been translated, ready for immediate downloading to the camera.

6.3   Save

This button will write all the settings on the screen away into an initialisation file. The next time the CT-Load application is started all the previous settings will be re-loaded.
There is the choice of writing the settings directly to CT-Load.ini or saving under a different name – e.g. CT-Load.sav

7   Initialisation file

The text in the initialisation file is divided into sections (as in a standard Windows .INI file)

[Misc]	*General camera settings*
DLLName	Name of the frame-grabber .dll file for serial communications
Autostart	=1 automatically open the frame-grabber channel on start-up
Sim	=1 allow operation without frame-grabber (e.g. for making command files)
Debug	=1 enables debug mode
Comport	=1 enables communications via COM1 (=0 disables serial comms)
Baudrate	=9600,N,8,1 (default comms settings for the camera's control processor)
[Camera]	*Specific camera settings*
Type	Camera name used for the Open command in CCAPI (e.g. BCi5 USB)
[Multislope]	*Settings for multi-slope operation*
Timex	Integration time for region (x = 1, 2, 3)
Voltsx	Reset voltage for region (x = 1, 2, 3)
Multi	=1 enables multi-slope operation

8 Serial communication protocol

8.1 Command Message format

Command messages use the standard (Intel) format for HEX records.

The message consists of ASCII characters 0 to 9 and A to F except for the first character, which is a colon.

Commands sent to the camera with the `clSerialWrite` function have the following message format:

:	Length	Address	Record type	Data	Checksum

Field explanation :

:	The first character indicating the start of a new message
Length	The length of the Data field in bytes (= number of characters / 2). Is always '02'
Address	This field always contains '0000'
Record type	Must always be 'BC'
Data	This field contains 2 bytes (4 characters) that contains the actual camera command (see command list)
Checksum	8 bit checksum code. Sum, modulo 256, of all fields (bytes) except the ':' including checksum field must be zero.

Example :

   `:020000BCFF80C3`   (Camera start command = FF80 hexadecimal)

Checksum = $256 - \mathrm{Mod}^{256}(02 + 00 + 00 + 0xBC + 0xFF + 0x80) = 0xC3$
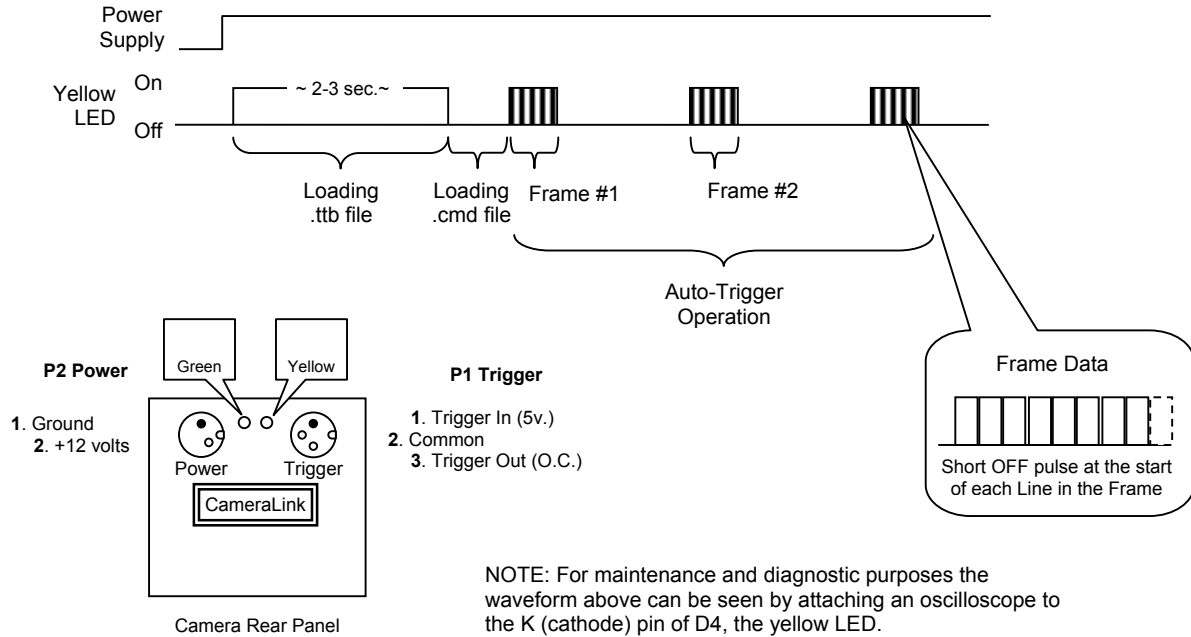
8.2 Camera Response format

The camera always responds with one of two characters:

ACK	0x06	Command accepted
NACK	0x15 (21 decimal)	Checksum or length error

9 BCi5 LED operation

Operation during the power-up sequence.

By observing the following sequence during the power-up phase you can see that the camera is correctly programmed

NOTE: For maintenance and diagnostic purposes the waveform above can be seen by attaching an oscilloscope to the K (cathode) pin of D4, the yellow LED.

Possible combinations of LED states:

Green LED	Yellow LED	Possible cause
On	On for some seconds then flashes regularly	Camera operation is OK
On	On for some seconds then Off	.TTB file loads OK but the command file is not present -- or -- the command file does not activate Auto-Trigger
On	Flashes once only.	The .TTB file is not present in the camera's memory or can not be loaded correctly
Off	Off	Power supply or major internal fault