



*Making the invisible visible*

# UVi Camera Intensifier



## **OPERATOR'S MANUAL** *UVi Camera Intensifier*

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The Invisible Vision UVi range of camera intensifiers are designed to add low light intensification, ultra high speed shuttering and UV to visible conversion in an accessory unit designed for high speed cameras and video systems. Various options exist as to intensifier format, size, photocathode and output phosphors but as standard the UVi comprises a custom designed 18mm diameter, high resolution generation II, micro-channel plate (MCP) quartz input intensifier incorporating a high efficiency, medium fast, green, proprietary phosphor (10 to 20 $\mu$ s decay) capable of light gain levels greater than 100,000. This phosphor has been chosen to match the majority of applications but for those wishing for an even faster framing rate the less efficient P46 (< 1 $\mu$ s decay) phosphor is offered as an alternative. Various photocathode spectral response curves are available but as standard an optimized broad spectrum photocathode is produced with good response from 200nm to > 800nm. Better UV response may be optionally chosen at the cost of a reduced visible light sensitivity.

The output image from the intensifier is relayed into the external camera by means of an internal NA 0.36 50mm equivalent focal length relay lens coupling into the external (supplied) 50mm Nikon f/1.4 camera objective / interface lens. The user may interchange this lens for lenses with differing focal lengths which will change the system magnification to suit other sensor formats. However with the supplied lens the system will operate at its maximum efficiency with 1:1 magnification. The external lens is also responsible for fine focus adjustment to accommodate any tolerance or error in the external camera's back focal length (or register).

For alternative camera mounts, the user can easily interchange the supplied Nikon lens for a similar lens bespoke to alternative manufacturers or employ an F to C mount adapter for C mount cameras. The lens mounts to the UVi via the industry standard M52 x 0.75 filter thread.

The UVi may be controlled and programmed by two methods; normally by direct manual control from the unit's built-in LCD keypad or via a remote PC and the USB interface. For PC control a simple Microsoft Windows compatible graphical control programme is provided.

Exposure and inter-exposure or delay times are controlled by the system's in-built electronics. Exposures from 10 nanoseconds (UVi intensifier is specified to 30ns) to over 1 millisecond may be selected with inter-exposure times from 30ns to 10ms. Multi-exposures or 'bursts' (up to 115) are allowed within any one sequence, each exposure and inter-exposure time being independently programmed within the above limits. Hence it is possible to operate at up to 25,000,000 fps in 'burst mode' at low repetition rates.

In addition, the initial delay from trigger to the first exposure, the input trigger signal, the gate monitor (as a default follows the shutter) and the external strobe outputs may all be programmed locally or remotely. Trigger modes available are TTL positive or negative edge, composite video field or frame synchronization and self powered make or break contacts. Both the strobe and gate monitor outputs (50 $\Omega$  capable) are programmable and suitable for triggering external events such as flash guns, further cameras or the experiment.

UVi systems are fitted on the optical input with a standard Nikon objective F-mount to accept standard Nikon lenses. No auto focus or metering facilities are available, although auto focus lenses may be fitted but manually operated.

All systems are powered by an external auto ranging AC to DC adapter (16V) as supplied. Alternative adapters should not be used.

As with all image intensifiers, the systems micro-channel plates have a certain life after which their gain reduces. Care must be taken not to abuse the image intensifier which would unnecessarily shorten this useful life despite its rugged, custom, long life design. Leave the system imaging (gating) *only* when required and when not in use replace the front lens cap. Try to avoid localized bright spots or laser beams.

The UVi incorporates several safety features and time-outs to help protect the system. These include automatic monitoring of the output brightness and several sleep or power down modes if left unattended.

## **WARNING**

***IMAGE INTENSIFIERS ARE VERY SENSITIVE TO INPUT LIGHT***

***DO NOT LEAVE RUNNING ANY LONGER THAN NECESSARY***

***DO NOT LEAVE IT EXPOSED TO OVER BRIGHT CONDITIONS  
ESPECIALLY IN THE 'EYE' MODE WITH THE SELF-PROTECTION  
SWITCHED OFF***

***WHEN NOT IN USE REPLACE THE LENS CAP***

***PLEASE READ THE MANUAL !***

*Continued exposure to over-bright or excessive input or output conditions will  
unnecessarily reduce the gain or useful life of the intensifier.  
Please treat with care.*

#### Intensifier

Input Window  
Photocathode  
  
Output Window  
Phosphor  
Gain  
Output Diameter  
Gating  
Resolution

#### **Full Custom, integral MCP design.**

Quartz.  
S20 / S25, 200nm to > 850nm (UV to NIR).  
Typically 600 $\mu$ A/lumen (white light).  
Fibre Optic.  
Proprietary green, decay – typically 10 $\mu$ s.  
Up to 400,000 ('photon counting').  
18mm.  
30ns Minimum (standard unit).  
27 lp/mm.

#### Optics

Input  
Internal  
External  
Output Image Format

F – mount.  
Integral NA 0.36 50mm lens system.  
Mated f/1.4.  
Maximum usable diameter 17.5mm.

#### System

Exposures  
Delays  
Burst mode / Multiple Exposure  
  
Gain Control  
Triggering  
  
Outputs  
  
Protection

All electronics/controls included within unit.  
Menu driven LCD control panel / indicators.  
USB port and graphical user interface s/w.  
Crystal controlled timing accuracy.  
30ns to > 1ms in 10ns steps.  
50ns > 10ms in 10ns steps.  
Up to 100 consecutive programmed delays/exposures per input trigger.  
User programmable 0 to 100% (12 bits).  
TTL Positive, TTL Negative.  
Make / Break (self powered).  
Comp. video frame / field synchronization.  
User Programmable TTL shutter monitor.  
User Programmable TTL 'strobe' output.  
Automatic over-brightness (user controlled).  
Run timeout (user definable).  
Sleep mode if left unattended.

#### Environmental

Dimensions (approximate)  
Weight  
Power  
  
Temperature  
Construction  
Mounting  
Documentation and Software  
Packaging

105 x 85 x 180mm - including output lens.  
< 1.5Kg.  
16W (16V DC @ 1A max.) via supplied AC/DC adapter and leads (90-264VAC).  
0°C to 40°C, non-condensing humidity.  
Aluminium housing.  
1/4-20 UNC thread on base.  
Supplied on CD.  
Flight box.

#### **CE and RoHS (Pb free)**

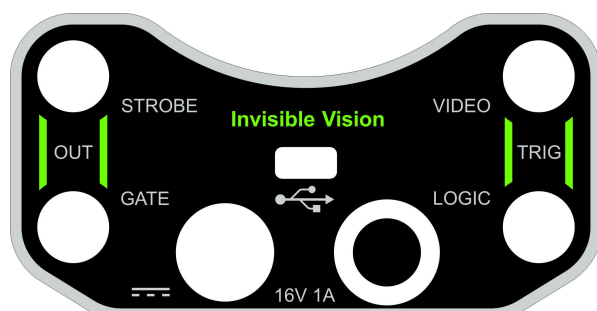
## Control Panel & Connections

### UVi LCD Control Panel



LCD Display	20 x 2 characters plus backlight.
◀	Left cursor key.
▶	Right cursor key.
OK	OK data entry key.
QUIT	Quit data entry key.
EYE	Yellow LED illuminates in Eye viewing mode.
READY	Green LED illuminates when UVi is ready for triggering.
TRIG	Red LED illuminates when UVi has been triggered.
POWER	Blue LED illuminates when power is present.

### UVi Connector Panel



USB	USB 2.0 type mini B.
Strobe	BNC 50Ω 5V Strobe output.
Gate	BNC 50Ω 5V Gate monitor output.
Video	BNC 75Ω Composite video trigger input.
Logic	BNC 50Ω 5V logic level trigger input.
Power	DC 16V 1A DC connector.
Fan	5V DC

### Welcome Screen

Immediately after switch on, the LCD display panel will display :

This is known as the 'Welcome' menu.

```
Invisible Vision Ltd
Welcome to UVi! >OK<
```

Press the **OK** key to continue.

The 'Top' menu appears:

```
Menu:      UVi Stopped
>RUN<SET SINGLE EYE
```

### Cursors and Controls

Note the flashing cursors ►◄ which identify which command will be actioned if the **OK** key is pressed. Using the ◀ or ▶ keys will move the flashing cursor to a new position. The **QUIT** key may be used at any time to step back up the menu 'tree' or abort a command.

**RUN** and **SINGLE** are the two instructions which arm the UVi ready to receive a trigger signal with **EYE** the command to put the UVi into 'eye-ball' mode. These instructions will be described more fully later in the manual.

*RUN will set the UVi to automatically re-trigger continuously upon an input trigger i.e., every time an input trigger is received, the unit will run the pre-programmed shutter sequence. This is the normal mode of operation with high-speed cameras.*

*SINGLE will set the UVi to only accept one trigger signal and then stop. This feature is useful with 'still' or single shot cameras.*

### Data Entry

From the top menu above, select **SET** using the flashing cursors and the **OK** key. **SET** (abbreviated for 'Setup') is the main sub-menu for nearly all of the timing and programming functions.

The 'Setup' menu appears:

```
Setup :    UTILITIES
>DATA<GAIN TRIGGERS
```



DATA is the submenu to programme the gate, gate monitor and output strobe, GAIN sets the UVi intensifier gain 'off-line' and TRIGGERS selects the input trigger mode. Finally UTILITIES is a sub-menu whereby the user is allowed to change such parameters as the LCD backlight and UVi automatic protection.

Select DATA with the cursor (◀ or ▶ keys) and **OK** key to enter the timing menu.

The 'Timing Data' menu appears:

```
UVi Timing Data :  
>SHUTTERING<STROBES
```

SHUTTERING enters the sub-menu to programme a shutter sequence; STROBES a sub-menu to set-up the external output strobe or trigger.

## **Gate Monitor / Gate Timing Selection**

Select SHUTTERING

The 'Monitor' or Gate selection menu appears:

```
Monitor off = Gate  
Select MONITOR>GATE<
```

This user may choose to either programme the physical UVi gate (shutter) or the gate monitor channel (output on the 'gate' BNC on the connector panel). Note that if the MONITOR is left off or in default, or set to zero microseconds then the gate monitor will follow the physical gate. However, there may be circumstances whereby the user wishes to alter the relationship between gate monitor and actual gate (i.e. for the gate monitor to 'lead' the gate by a few microseconds to trigger a light source) or to use the gate monitor channel as an extra independent programmable strobe channel. This is the purpose of allowing this channel to be independently programmed.

Selecting MONITOR produces the SMON menu:

This operates in identical fashion to the gate menu which is described below. QUIT will return to the previous menu.

```
SMON Te 000000.00 µs  
DELAY : 000000.00 µs
```

Entering a zero value for the delay (as above) results in the default mode of gate monitor operation whereby the gate BNC output follows the physical shutter.

## **Gate Timing**

Select EXPOSURES

The 'Gate' menu appears:

```
Gate Te 000000.00 µs  
DELAY : 000000.00 µs
```

The top row (**Te**) figure indicates **T**otal **E**lapsed time from time zero i.e. the input trigger at which time the event such as a delay or exposure referred to in the second row will take place. This Te is most useful when programming a multi-exposure sequence from an input trigger as it will automatically calculate the absolute time of an 'event' such as an exposure from time zero at any point in the sequence.

The lower row requires a DELAY to be entered (this is the time from trigger input to the first exposure).

Note that the cursor has now changed to an single 'underline' character (such as 0) within the delay number. This new cursor may be moved around with the cursor ◀ or ▶ keys as normal. To alter a digit within the delay number, select the required digit with the cursor keys. Holding the cursor key 'down' on a selected digit will then make the digit automatically count up or down (dependent upon which cursor key is held), rolling through zero. When the required value has been reached release the cursor key. Another digit may then be selected if required.

Once the user is happy with the delay value press the **OK** key. If the delay time entered is within the UVi specification the number will be accepted and the delay value will also be entered into the Te position on the top row. If the value entered is outside the range of allowable values a self explanatory error messages will appear for about 3 seconds before allowing the user to correct the mistake. Assuming a correct delay entry (i.e. 1µs) then the display will update to require a first exposure time.

Entry of first exposure:

Gate	Te	000001.00	µs
EXP	01	000000.0 <u>0</u>	µs

The second row of the LCD panel now requests a first exposure time EXP 01. Again the number may be edited as before with the cursor keys within the maximum and minimum exposure limits (10ns to 1ms in 10ns steps). Again accept the value with the **OK** key and note how the value of Te changes to reflect the total of the delay plus first exposure. Assuming a correct EXP 01 entry of 100ns, the display will update to:

Entry of first inter-frame (IFT1) time:

Gate	Te	000001.10	µs
IFT	01	000000.0 <u>0</u>	µs

At this point, with one first delay and one exposure time entered the unit will now enquire as to a second delay or 'interframe' (IFT) value. This feature should not be confused with the interframe time on any external camera, but as the time between two successive exposures on the UVi when responding to a single input trigger pulse i.e. if we require the UVi to shutter twice (or more) in quick succession per external camera frame.

The user may continue to enter an IFT 01 time as per the previous DELAY, and which if selected will then require a second exposure (EXP 02) time and so on for a maximum of 115 exposures.

Note how the value of Te increases with each entry. The **QUIT** key may be used at any time to step back to a previous entry if required.

To finish gate timing data entry use the **OK** key to enter a ZERO value when the UVi requests an IFT (or delay) time. For example, using the first interframe time menu as above with zero interframe time, pressing the OK key will result in:

'Sequence End' menu :

Sequence End?	>OK<
IFT	01 000000.0 <u>0</u> µs

Press **OK** to accept the programmed gate data and to return to the timing data menu. Using the **QUIT** key will return the user to the previous entry for IFT 01 time (zero) menu as above.

Having entered the shutter timing data, the user may proceed to programming the output strobes from the 'Timing' sub-menu if required.

## Strobe Timing

Select STROBES from the timing data sub menu.

'Strobe' menu:

```
Set Output Strobe 1
Strobe: 000000.00 µs
```

The strobe or external output trigger timing data runs in parallel with the exposure and interframe timing data entered earlier; the strobe capable of being set at any time before, during or after the exposure sequence. Again strobe times are edited and selected in an identical fashion as shutter data but note :-

All external strobe times are absolute values from time zero.

The UVi as standard only has one physical strobe output channel available (Strobe 1). However up to 4 strobe channels exist internally within the UVi which may be programmed. Occasionally this may be useful in locking out spurious input triggers in an electrically noisy environment i.e. if we are synchronizing to a 1000 fps camera then we could set an otherwise unused strobe channel to 950µs in order to guarantee that the UVi would ignore any trigger signal at a period of less than this figure as it would still be executing the previous sequence.

Strobe data entry may be halted at any time by entering a zero time for a value as per the gate or gate monitor data on IFT times. Alternatively, upon entering the 4<sup>th</sup> and last strobe the UVi will enquire:

'Strobe Off/Finished' menu:

```
O/P Strobe Off? >OK<
Strobe: 000000.00 µs
```

Note that entering a 'zero' value for any strobe will turn off that strobe channel and all higher strobe output channels. More flexibility is possible if programming the UVi via its USB control.

**QUIT** as usual will always return the user to the last menu. Selecting **OK** will enter all external strobe data and return the user to the timing data sub-menu.

## Gain

From 'Setup' menu, gain may be set 'off-line' with the unit in 'idle or stopped' mode. Gain is however normally adjusted with the unit actually running under the RUN or SINGLE menus.

From the set-up menu select GAIN

```
Setup : UTILITIES
DATA>GAIN<TRIGGERS
```

The 'Gain' menu will appear:

```
< Adjust Gain > 15%
|||.....
```

Within the gain sub-menu, the user may use the cursor ◀ or ▶ keys to increase or decrease the gain setting – the bar-graph display increasing or reducing as appropriate. Note that the actual UVi system gain, although given as a percentage is not linear, increasing rapidly at the high end.

*Start low and increase if necessary.*

Once satisfied with the gain, use the **OK** (or **QUIT** to abandon) key to enter and return to the Setup menu.

## **Input Trigger Selection**

Again from the top menu, select TRIGGERS

```
Setup :   UTILITIES
DATA GAIN>TRIGGERS<
```

The 'Input Trigger' menu:

```
I/P Trigger:
>TTL<C.VIDEO MANUAL
```

The three input trigger modes are TTL, Composite Video (C.Video) and Manual. They may be selected with the cursor ◀ or ▶ and **OK** keys. Default is TTL positive.

## **TTL**

This mode allows the user to select the Logic (TTL) input BNC port on the UVi connector panel and programme the UVi to accept either a TTL positive (+ve), a TTL negative (-ve), or a self-powered make or break signal. In the make or break modes, the UVi outputs a 5V logic high via an internal 470R resistor and then looks to detect the TTL BNC input line being pulled low (a short or 'make') or alternatively being held low and then released to pull high via the 470R resistor ('break'). As the impedance is relatively high, it is not advisable to drive long input trigger leads in these self-powered make or break modes.

'TTL Trigger Input' menu:

```
TTL Trigger Input:
>+ve<-ve MAKE BREAK
```

As per usual, select the required option with the cursor ◀ or ▶ keys and the **OK** key.

## **Composite Video**

This mode allows the user to synchronise the UVi to an external video camera via its built in video synchronization stripper using the video input BNC connection. Under the composite video menu, further options are provided for either field or frame (25/30Hz or 50/60Hz) synchronization operation. Note that the video input BNC is not terminated and high impedance such that if used in isolation an external 75Ω termination resistor is recommended. Composite video trigger mode will not operate with SINGLE shot operation.

'Video Trigger Input' menu

Video Trigger Input:  
>FIELD<FRAME      Sync.

As per usual, select the required option with the cursor ◀ or ▶ keys and the **OK** key.

## **Manual**

This selection sets the UVi to operate in 'single' shot mode upon any key-press of the RUN or SINGLE on menu entry on the control panel. Each key press will then trigger the UVi once.

## **Utilities**

The Utility functions are accessed from the 'Setup menu', moving the cursor to the top row. These functions allow the user to switch on/off the LCD backlight, disengage the automatic over brightness protection, adjust the run time-out value and finally report build status of the unit.

Selecting Utilities

Setup :    >UTILITIES<  
         DATA GAIN TRIGGERS

The 'Utilities' Menu :

UVi Utilities Menu  
>LCD<IMAX WAIT INFO

## **LCD**

Entering the LCD command in the Utilities menu allows the user to switch on or off the LCD backlight.

The LCD menu :

LCD Backlight Mode  
Select :       >ON<OFF

## **IMAX – Screen Current Limits**

This menu allows the user to override the built in intensifier protection mechanism.

The UVi measures the average screen current and if this average 'brightness' should exceed an internal limit, the unit automatically reduces the gain to a safe level by reducing the gain by 50% and checking again. However, the UVi has no knowledge as to the nature of the scene being viewed, whether it has localised 'bright spots' in a generally dark field or a very bright but uniform background. Hence the actual setting of the screen current limit is somewhat arbitrary, the level being chosen to warn the user to consider the scene being imaged. Localised bright spots are far more damaging than an even general illumination, the UVi screen current limit being set deliberately low to 'catch' more easily localised bright spots. With care, the I-limits may be switched to 'off' but will always automatically reinstate themselves after every trigger sequence.

Another factor to consider is that the 'average' screen current will increase both with framing frequency and exposure time.

## OVERRIDING THE I-LIMITS WILL SWITCH OFF THE PROTECTION.

Select I-limits from 'Utilities

```
UVi Utilities Menu
LCD>IMAX<WAIT INFO
```

Select YES if you're sure

```
Override Intensifier
Limits?           >YES<NO
```

A double check!

```
I.I. Damage Possible
Are You Sure?     >OK<
```

QUIT at any time in the above menu sequence will leave the intensifier limits switched in. Use the OK key in the last menu to switch the screen current off for the next 'run' only.

Note that several key pad strokes are required to set the I-limits to off. With the PC USB interface in operation, the OVERRIDE command (or a right click in the UVi software) may be issued to immediately disable the I-limits.

### Wait

Once the UVi is active and 'running' it times the duration if left in this mode and will automatically stop after a preset time-out to protect its-self as if forgotten. This time-out value is factory preset at a value of about 150 seconds. However, the value can be changed in multiples of approximately 25 seconds via the WAIT menu from UTILITIES. The default value is '6'.

Wait Menu :

```
< Run Timeout > 40
|||||||.....
```

Within the wait sub-menu, the user may use the cursor ◀ or ▶ keys to increase or decrease the run timeout setting – the bar-graph display increasing or reducing as appropriate.

### Info

This menu is used to report build status of the UVi.  
It reports software version and type / serial number.

Typical 'Info' display :

```
Firmware UviCore2v3a
S/N 1850-0UA0017>OK<
```

Only the OK and QUIT keys are active and will return to the UTILITIES menu.

## **OPERATION**

From the 'Top' menu the three major operational modes of the UVi may be accessed.

The 'Top' menu:

Note that UVi is 'Stopped'

<b>Menu:</b> UVi Stopped >RUN<SET SINGLE EYE
---

### **General Operational Comments and Good Practice**

- **Start at Low Gain**

Always start at low gain / illumination / aperture conditions and increase until acceptable.

- **Set Camera to High Sensitivity**

Ensure that any following CCD or FILM camera is operating at maximum sensitivity (i.e. most high speed video cameras offer a +6db gain option)

- **Run Timeout**

The UVi has in addition to the IMAX current limits (below) a 'time-out' feature. This feature will automatically switch the unit back to 'idle' or 'stopped' mode from any of the operational modes after a preset time. The intention is to prevent the system being left unsupervised and 'running' when not in use. As a default, this time is set to approximately 150 seconds (2½ minutes) but may be changed via keypad (WAIT menu) or USB interface.

- **IMAX I-Limit / Current Limit**

If the current limit (IMAX) condition has not been overridden, The UVi when running in RUN or EYE modes may indicate that it has REDUCED GAIN or even switch off, due to the output brightness having reached the safety limit. The gain will normally reduce by one half. This value of reduced gain will be retained until modified by the user. Occasionally this effect might also occur when changing the gain in a single large jump or when first going from 0 to 1%. This effect should be ignored and the correct gain re-entered.

- **LCD Control Panel / USB Interface Contention**

If the UVi is operated by both its integral LCD control panel and USB interface it will respond to the last command sent by either interface. If the GAIN was last set by the USB interface (in 4095 steps) then this will be the gain used and not that displayed on the LCD panel. Equally, should the gain be set by the LCD panel then this will override the gain set by the USB. This is important to note as if the UVi current limits become active to reduce gain, the gain will be updated on the 'active' interface and not necessarily shown on the other. In the event that the unit shuts down completely and 'STOPS' or times-out then both systems will react and synchronize.

- **Sleep Timeout**

If the UVi receives no user input either on the LCD control panel or USB interface for a period of about 50 minutes the UVi will sleep, reducing MCP gain to zero and returning to idle mode. Timing data will remain valid but the gain will need to be reset before the UVi can be reused.

## **Run**

This command places the UVi in a mode whereby every appropriate input trigger as defined under the trigger menu will cause the UVi to action the pre-programmed sequence up to the limit of the run time-out.

Select RUN from the 'Top' menu

Input Trigger Detected :

**UVi Running Sequence**  
**>STOP< GAIN : 15% <>**

No Input Trigger :

**UVi Awaiting Trigger**  
**>STOP< GAIN : 15% <>**

Two possible messages may be displayed as determined by the presence or otherwise of an input trigger signal. If an input trigger signal is present then the UVi will flash it's red 'triggered' LED on the display panel and identify its state via the LCD display. Note that if the input trigger duty cycle is extremely low, or the repetition rate very slow then the user may notice the UVi alternate between both of the above menus. This is however perfectly correct. In addition to the red 'triggered' LED flashing, the green 'ready' LED will also remain on.

When the UVi is operational or active, the gain may be adjusted with the ◀ or ▶ keys from 0 to 100%.

The only menu option available is to STOP the unit, either by pressing the **OK** or **QUIT** keys. Both options will close the shutter and disable further triggers, returning the UVi to the 'Top' menu.

## **Single**

This command is identical to RUN except that only the very first received trigger will be actioned, all other subsequent input triggers being ignored.

'Single' menu :

**Awaiting Single Trig**  
**>STOP< GAIN : 15% <>**

Once this mode has been entered, the green 'ready' LED will illuminate and the UVi will then wait for single input trigger. When the trigger is received, the UVi will 'run' its pre-programmed sequence, illuminate the red 'triggered' LED and return to the 'Top' menu in 'idle' mode.

## **Eye**

This command is used to place the UVi in a DC intensifier 'on' mode. The mode should only ever be used for 'eye-ball' viewing as the UVi is really acting as a normal 'night-sight' device, unshuttered, for extremely low light operation. All programmed data is ignored with only the gain control operative. Note that the yellow 'Eye' LED will light when EYE mode.

'Eye' menu :

**Caution: DC Eye View**  
**>STOP< GAIN : 15% <>**

Again, the gain may be adjusted in by the use of the ◀ or ▶ keys from 0 to 100%. Both the **OK** and **QUIT** keys will exit EYE mode and return the UVi to its 'idle' or 'stopped' state in the 'Top' menu.



In addition to controlling the UVi via its integral LCD keypad, the unit may also be completely controlled and programmed from a PC via a USB port using the UVi control software. The software has currently been tested to work under Microsoft Windows 2000, XP, and Vista (Basic Edition). The unit may also be controlled via its own low level command language with any suitable terminal programme (HyperTerminal etc) and appropriate virtual com port drivers.

Connect the UVi to any unused USB 2.0 port on a PC via the supplied 2m USB lead. The supplied UVi control software upon installation will automatically install drivers and discover the port.

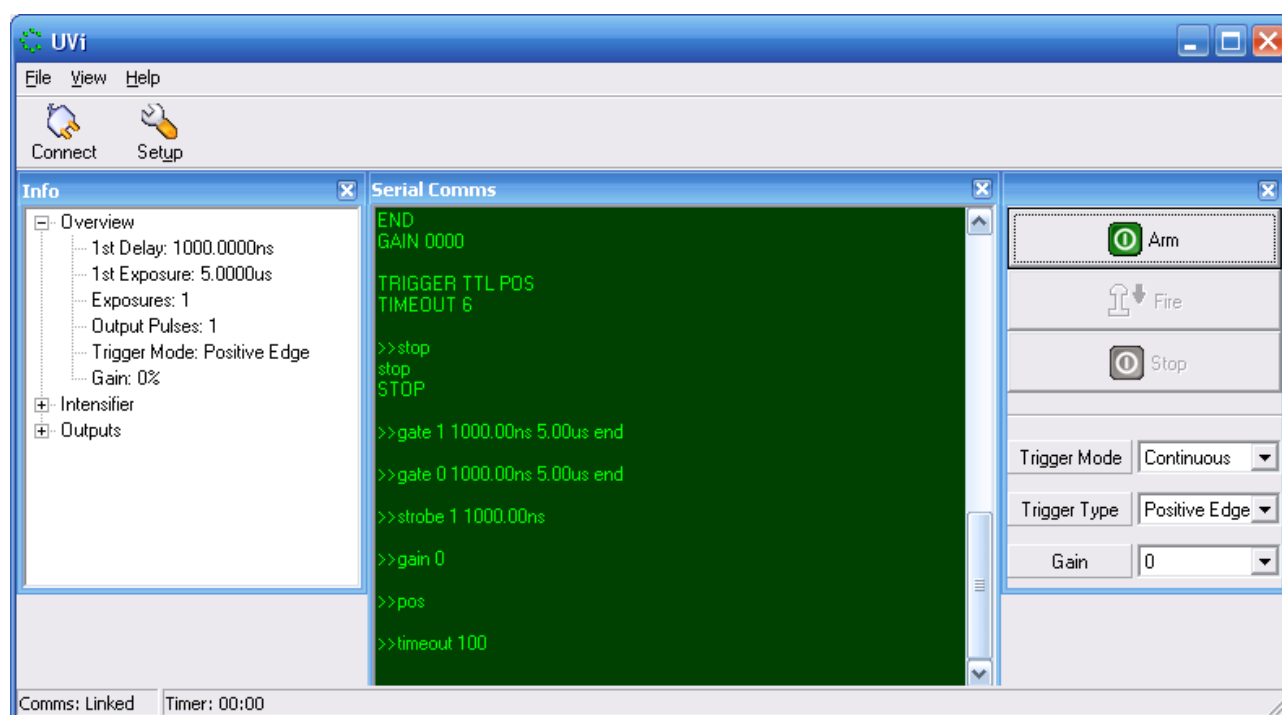
Full user instructions for using the UVi with the supplied software are present within the supplied software system as help files. Hence this manual only references installation and low level commands for alternative systems.

## Installation of UVi Software

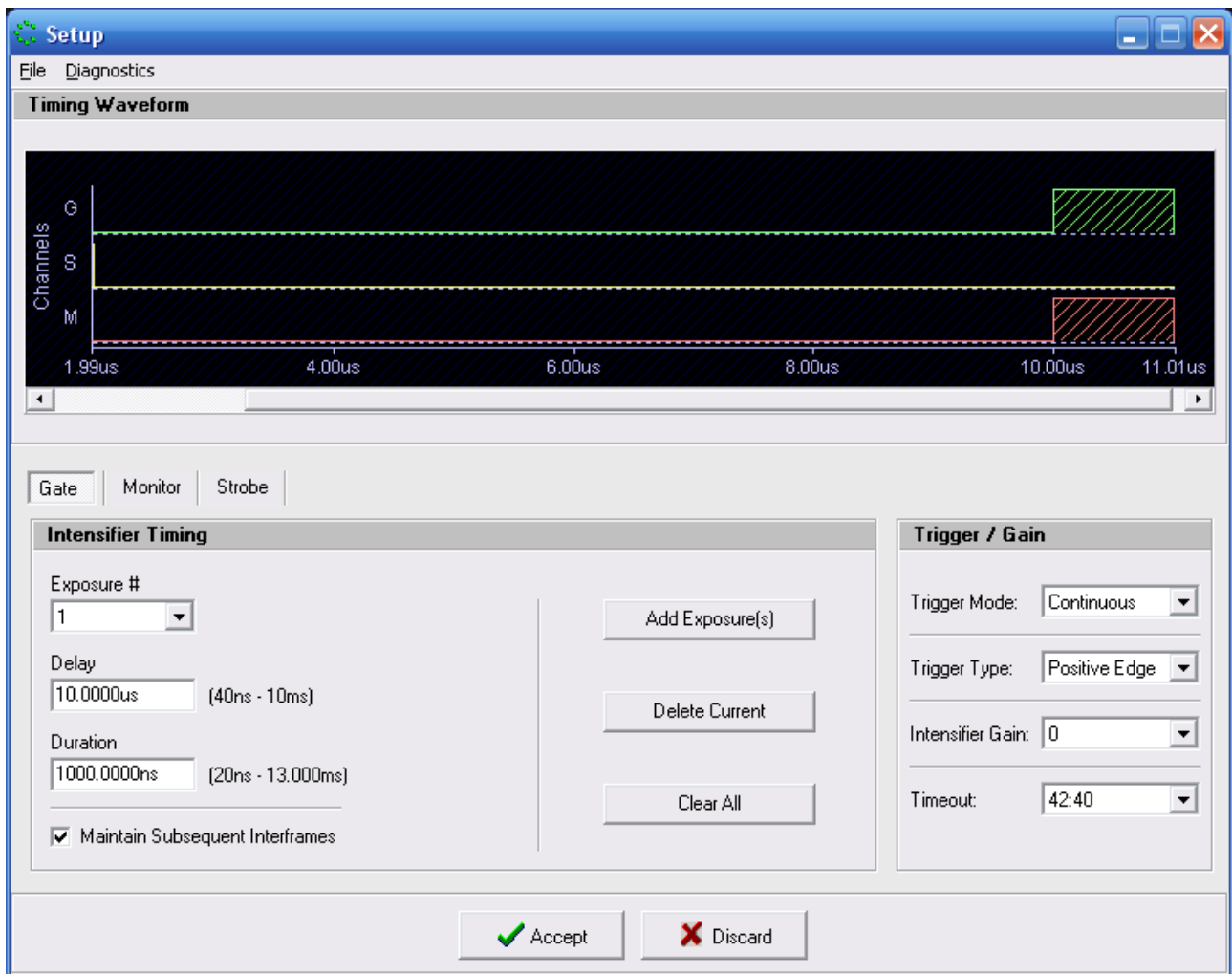
The UVi software is supplied on a master CD. Insert the CD into the host computer and manually run setup.exe if it does not auto run. Follow the on-screen set-up instructions. The software may be copied as often as desired.

Optionally, the user may create a dedicated UVi gain table. This is used by the UVi software to convert the gain settings within the software to customized gain settings on the UVi, and allowing the user to calibrate the system if required i.e. to create photographic 'stops'. To do this the user needs to create a text file 'gaintable.ini' and place this file in the same directory as the UVi executable. In the absence of this file, the software reverts to a default mode. Note that gain values as described within the gaintable.ini file are checked by the UVi hardware to ensure that it cannot exceed a safe limit.

Full instructions to create this table and file exist within the software help menus plus a factory supplied gaintable.ini file is supplied on the install CD.



Typical UVi control software (full expanded mode) screen shots.



## UVi Low Level Command Structure

All of the UVi USB commands are directly analogous to the LCD display menu options and act immediately. In addition, there are also a few 'extra' commands such as *STATUS* that return the current settings of the UVi.

It is also possible to create 'text files' in a separate editor and then transfer these files via a terminal programme to the UVi. In effect the text file is 'typed' into the UVi directly.

## Programming Example

A complete list of UVi commands follows later but an example of a programming 'session' is given below as a fast learning 'start'. The following data might be typed directly. Note that when typing directly in terminal mode the UVi does not recognise <delete> or <back-space> and is case insensitive.

*Gate 1 1.6ms 2us 10us 2us 10us 1us 20us 500ns end*

*Strobe 1 1.4ms*

*Strobe 2 1.5ms*

*Pos*

*Gain 1000*

This would provide an :

Initial delay of	-	1.6 milliseconds
1st exposure time	-	2 microseconds
1st interframe time	-	10 microseconds
2nd exposure time	-	2 microseconds
2nd interframe time	-	10 microseconds
3rd exposure time	-	1 microseconds
3rd interframe time	-	20 microseconds
4th exposure time	-	500 nanoseconds
a strobe output at	-	1.4 milliseconds
a strobe (internal)	-	1.5 milliseconds
an input trigger	-	TTL positive.
a <i>GAIN</i> setting of	-	1000

The *GATE* command is followed by a sequence of numbers Channel, Delay, Exp1, lft1, Exp2, lft2, Exp3.....until the END statement. Note that the data must finish with an exposure time.

Strobes are followed by the strobe channel number and then an absolute time.

*POS* is the abbreviation for TTL Positive and *GAIN* is self explanatory (0 to 4095).

## **Delimiters**

You must use a delimiter between each data instruction. The three allowable delimiters are:

< space >      < comma >      < carriage return >

## **Units**

You may use the abbreviations :

ms	-	for millisecond
us	-	for microsecond
ns	-	for nanosecond.

These units may be mixed freely with exponents and decimal points. Minimum time granularity is 10ns. Examples of valid 'times' would be :-

0.1ms	
1.0E+03us	
100000ns	All equivalent to 100us
100E+03ns	

## **Minimum and Maximum Times**

	Minimum	Maximum
Initial Delay	100ns	10ms
Exposure Time	10ns	1.3ms
Interframe Time	30ns	10ms

The user may freely experiment with the other simple self explanatory commands, all of which are almost identical in operations to their keyboard equivalents.

Errors will be trapped, explained and reported to the terminal programme accompanied by a 'beep' signal.

The UVi does not recognize <delete> or <back-space>.

The timing data can be checked by *STATUS*. The UVi will respond with a fixed format list of timing data (delay, exposures and interframe times, triggers, strobes, gain plus operational mode (ready, running, triggered etc.).

Finally, selecting *RUN* or *SINGLE* will set the camera ready to receive a trigger signal

*STOP* will return the UVi to 'idle' mode as per normal.

## **UVi Unexpected Responses**

The UVi in USB mode responds with ASCII messages to events such as errored commands or time-outs and IMAX gain reductions etc. These are in general designed to be human readable messages for operation in a conventional terminal mode but may also be witnessed in the UVi software when operating in diagnostic mode.

The most important response is *STOP* which will occur if the UVi is disarmed for any reason i.e. the user choosing a *STOP* menu option, a run timeout, the IMAX limits switching the UVi off or if left for nearly 50 minutes without any interaction upon which the UVi will enter a sleep mode and reduce intensifier gain to zero.

## **Command List**

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The following is a complete list of all user UVi USB interface commands in alphabetical order.

### **1. BREAK**

Programmes the UVi for TTL trigger input, break contact.

### **2. EYE**

Places the UVi in DC or continuously on (unshuttered) mode. This mode is truly equivalent to normal intensifier night-sight operation for 'eye-ball' viewing. The *STOP* command will return the unit to idle mode.

### 3. FIELD

Programmes the UVi for Video trigger input, field synchronization (50/60Hz).

### 4. FRAME

Programmes the UVi for Video trigger input, frame synchronization (25/30Hz).

### 5. GAIN <parameter>

Sets the UVi gain with gain value as defined by the parameter.

<parameter> is an integer value between 0 and 4095 inclusive or limit imposed by UVi firmware. Maximum of 4 characters including leading zeroes.

### 6. GATE <channel> <delay> , <exp1>, <ift1>, <exp2>.....**END**

Allows the user to enter timing data into the UVi

Channel is an integer number between 0 and 12 inclusive, channel 0 being the gate monitor and channel 1 the physical shutter on the UVi. Channels 2 to 12 inclusive are for future product developments

Up to 115 exposures may be entered <i.e. exp115> within specified timing and memory limits.

The command must finish with END. Any errors will be reported upon data entry when the command will then abort completely.

### 7. MAKE

Programmes the UVi for TTL trigger input, make contact.

### 8. NEG

Programmes the UVi for TTL trigger input, TTL negative operation.

### 9. OVERRIDE

Overrides the UVi internal I-limits, for the duration of the next *RUN* or *SINGLE* command only. *STOP* command also has the effect of re-installing the I-limits.

### 10.POS

Programmes the UVi for TTL trigger input, TTL positive operation.

### 11.RUN

Sets the UVi into continuous re-trigger mode. The UVi will respond to every trigger received, running its pre-programmed sequence up to the limit of the internal timeout (c.f. *WAIT*) command). *STOP* command aborts sequence.

## 12. SINGLE

Sets the UVi into single shot trigger mode. The UVi will only respond to the first input trigger received, running its pre-programmed sequence and then halting in idle mode. The *STOP* command will also return the unit to idle mode.

## 13. STATUS

Enquires of the UVi the current timing data, trigger data and system status. The UVi will respond with a complete list of all operational parameters and it's current status.

## 14. STOP

Immediately disarms the UVi and returns to the idle state.

## 15. STROBE <channel> <Time>

Programmes the absolute timing data for the external output triggers.

<channel> is an integer value from 1 to 4 inclusive. Channel 1 is the UVi output strobe.

<Time> is a value from 100ns to 100ms as per UVi timing format

To turn off an output strobe enter the strobe channel with a time value of 0

STROBE 4 0 turns off strobe channel 4.

## 16. TRIGGER

Creates a software trigger for the UVi i.e. analogous to the keyboard 'manual' mode.

## 17. VERSION

Returns detailed build information on the UVi.

## 18. WAIT <parameter>

Modifies the internal time-out for *GO*, *SINGLE* and *VIEW* modes by multiples of approximately 25 seconds.

<parameter> is an integer value from 0 to 100 inclusive.

### **Synchronization to High Speed Video Systems (With TTL Pulse)**

The following discussion gives some general advice and wisdom on operating the UVi with high speed video systems. It is recommended to read and understand fully this section before combining the systems.

#### **Basic Concepts**

Virtually all high speed video systems generate an output pulse at the start of each frame. This pulse can be used to synchronize the intensifier exposure (or exposures) to the framing rate of the video system. Proceed as follows :

1. Connect the high-speed camera's TTL synchronization pulse output to the TTL input on the UVi. A good recommendation is also to set the UVi to TTL negative trigger and to terminate the 'coupling' BNC lead with 75Ω or 50Ω at the UVi input trigger. This reduces the risk of spurious noise trigger signals.
2. Most applications require only one exposure per frame, so the user need only enter two timing data values either via the local keypad or the PC.

1st.     -       Delay from the input trigger to start of the exposure.

2nd.     -       Exposure time.

It is always advisable to set the UVi exposure to near the beginning of each high speed camera frame to integrate as fully as possible the output phosphor of the UVi (including the phosphor tail or decay) before the following high speed camera frame is due.

Hence, assuming a system framing rate of 10,000 frames per second (interframe time of 100μs) and a 1μs per frame exposure, typical timing data would be:

*Delay 1μs  
Exposure 1μs*

This produces a 1μs exposure only 1μs into the 'new' high speed camera frame, leaving 99μs for the phosphor tail to die away before the next frame.

3. Occasionally, due to noise, it may become advisable to enter a 'dummy' external strobe output to reduce the risk of mis-synchronization or false triggering. Typical examples would be where an external noise source induces very short (10ns) or so noise spikes on the UVi input trigger line which the UVi then treats as input triggers. A good cure for this is often to set an 'idle' strobe output to just under the total system required interframe time. This has the effect of forcing the UVi to run for the full duration of its programmed sequence, including the dummy output, and hence can not be retrigged within this time frame until its sequence is complete.

In the above example this could be accommodated by setting

*Strobe 4 90μs*

4. Select the required GAIN.
5. On entering RUN, the above sequence will be run every time the input trigger is received, therefore a 1μs exposure will occur 1μs in from the beginning of each high speed camera frame.

6. With the UVi running, adjust gain and brightness as required. Beware of over illumination or localised bright spots within the image. If necessary, alter the IMAX current limits with care should the UVi always wish to reduce gain.

**Finally, always run the UVi for as short a time as feasible, especially when looking at bright objects. Use the *STOP* command as soon as the required recording has been made.**

Note that some cameras produce a continuous stream of synchronization pulses even when not capturing. These will continuously re-trigger and 'run' the UVi if left unattended.

## **Recommended Setup Steps**

*NOTE - The UVi system weighs 1.5Kg without the system objective lens and will require some support to relieve the weight burden on the rear mount.*

1. Complete the USB connection (if required) and the trigger / strobe BNC connections (ensuring that you have selected the correct trigger input BNC) between camera and UVi.
2. With unknown or little used cameras systems, it is often advisable to ensure that the output trigger from the high speed camera is suitable and being correctly received by the UVi prior to optically coupling the systems together. This is most easily achieved by electrically connecting the systems and then by 'eye' viewing the fast shuttered output of the UVi for operation. Once satisfied that the systems are operating appropriately proceed to couple optically.
3. Confirm the back focus distance is set approximately correctly from UVi to the sensor or film plane of the following camera system (i.e. 46.5mm for a Nikon F-mount or 17.56 mm for C-mount).
4. Using the interface lens (Nikon 50mm f/1.4 supplied) or equivalent attach to the camera system and to the UVi via the lens filter thread. Note that the output fitting on the UVi will rotate to ensure that the lens when fully home can be rotated to the correct orientation. This will also allow a C-mount adapter to attach to the system and tighten without the need to rotate the whole unit.
5. Fit a suitable objective lens to the UVi.
6. Connect the UVi to its AC-DC adapter and switch on.

## **Basic Focusing**

*Note - When linked to a camera recording system using the cameras shutter monitor output for synchronization, **do not use the EYE mode. EYE mode is designed principally for 'eye-ball' or DC use.***

Instead :-

1. Programme the UVi system, using either the local keypad or the PC to give an exposure of typically 10 $\mu$ s after a delay of 1 $\mu$ s (towards the start of the high speed camera frame).



2. Connect the output 'shutter monitor' trigger from the external camera system to the appropriate input trigger BNC on the UVI. In the case of a conventional TV camera use the Video trigger input BNC on the UVI with the composite video signal from the camera.
3. Select trigger mode, either TTL POS or TTL NEG (i.e. high speed cameras), FIELD or FRAME when used with a composite video signal.
4. Set a typical GAIN of 10%.
5. Close the aperture of the objective lens to the minimum i.e. F22 or F16.
6. Ensure that the high speed camera system is set to **maximum sensitivity** and **maximum allowable exposure time** (the UVI will be the shutter).
7. Point the complete system at the target and select RUN on the UVI. Run the camera system.
8. Gradually open the objective lens aperture until satisfactory brightness is achieved. Adjust focus.
9. If necessary, adjust UVI GAIN, LENS APERTURE and EXPOSURE time to obtain correct brightness.
10. You will almost certainly find it necessary to adjust the BACK FOCUS on the UVI via the focus ring on the interface lens between the two systems.

## **Synchronization to High Speed Film Cameras (With TTL Pulse)**

The synchronization of the UVI to film cameras is more difficult than for Video systems but similar concepts apply as per high speed video.

Most film cameras do not easily provide a frame by frame synchronization pulse as per high speed video cameras although some i.e. NAC E-10 do have upgrade facilities available. Should such a pulse be available, then the high speed film camera may be synchronized in the same manner as per high speed video cameras.

Without true synchronization, two approaches are possible.

1. To gate the UVI on for the whole duration of the film run
2. To programme the UVI to give a multiple exposure 'burst' of say 100 exposures with the UVI frame rate matched to that of the camera. However, this is problematic.

First, assuming accurate film camera speed control, then the user should also be aware of the film camera's shutter ratio.

Attempting to synchronize on to each film camera frame with short UVI exposure times, the chances that these exposures would correctly coincide with the true camera open shutter would largely depend on the shutter ratio used i.e. a 50% shutter opening ratio would stand a much better chance of coincidence than a 5% ratio. By chance, the user may successfully record all frames but there is equally a strong chance of missing all the frames. In this case, the only adjustment possible is by changing the value of the initial delay time.

## UVI 1850-10 OUTLINE DRAWING

