

HIGH-RESOLUTION DIGITAL AREA SCAN B&W CCD CAMERA

# NET145LA NET145CL

## User Manual

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## Important information



Before using this camera, please read the User's Manual carefully. The product has been safely designed to prevent malfunctions and accidents. Please observe strictly the handling precautions below. If faults are suspected, consult the shop for NET products nearest you without attempting to disassemble the camera yourself.

### Warning

Do not remove screws or covers to prevent fire or electric shock.  
Do not expose this camera to rain, directly to sunlight or moisture, nor try to operate it in Wet areas.  
Do not attempt to remove camera cover nor modify any unit.  
Warranty will be voided against the damage caused by you or any other equipment.

### Precautions

Do not attempt to disassemble, modify, or repair the camera.  
If you need, please contact New Electronic Technology.( "NET") for help.  
Do not directly shoot sunlight or strong spotlight to the camera for a long period.  
It may cause CCD blooming and permanent damages.  
Do not operate the camera beyond the temperature range and avoid using the camera over 90% humidity.  
Do not use unregulated power supply source.  
Do not clean CCD faceplate with fingers or any hard objects other than Lens tissue or a cotton tipped applicator and ethanol.  
Do not use the strong or abrasive detergents when cleaning the camera body.

### Limited Warranty

NET warrants only the original components to be free from defects in material for one year from the purchasing date. This warranty covers failures or damages due to defects in material, which would occur during normal use. It does not cover damages or failures, which result from shipment, mishandling, abuse, misuse, or modification.  
Any damage caused by improper handling will not be repaired by NET.

A Return Material Authorization (RMA) number is required prior to returning any NET product for repair or replacement.

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For technical assistance, please email to [info@net-gmbh.com](mailto:info@net-gmbh.com) or [info@net-usa-inc.com](mailto:info@net-usa-inc.com)

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## COMPLIANCE STATEMENTS for CE, FCC, MIC

To meet EC requirements, shielded cables must be connected to other devices for these cameras. These cameras have been tested in the compliant environment of a typical class A. It is assumed that the camera has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide the reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

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# 1. Introduction

## 1.1 Overview

The NET145LA or NET145CL are a 1.45 Mega pixel digital camera with an EIA-644 ("LVDS") or CameraLink standard interface. The camera is a high resolution B/W progressive scan CCD camera. The imager resolution is 1392 x 1040 pixels. All functions of the camera are adjusted via its digital and serial interface. For this purpose, NET145LA/NET145CL provides a user-friendly RS-232C as external port add to internal RS-232C, respectively.

It connects the camera ports with the serial port and frame grabber on the PC through customer's cable. Camera control program runs under WIN2000 / XP and gives control over the camera functions. A serial command is possible to fully control the camera functions using the windows hyper terminal independently. For this purpose, a well-known terminal program or any appropriate program may be used as well.

NET145LA/NET145CL has an exclusive built-in look-up table(LUT). This can be set at externally selectable functions such as gain, offset, shutter speed and others through the RS-232C. Details concerning the command code can be found in the section "Serial Command".

### ♣ What is LVDS or Camera Link signal?

LVDS is a Low Voltage Differential Signaling device which extends the performance of the commonly used RS-422 differential data bus. RS-422 limits the frequency to the 20 MHz range. However, LVDS clock support is over 65MHz (66 MHz NSC, 65 MHz TI) and improves the signal transmission of cables with 10m to 30m lengths. It also reduces the EMI significantly. The LVDS device is now called RS-644 and is pin-to-pin compatible with standard RS-422. If a frame grabber contains a RS-644 input, it can take both RS-644 data and RS-422 data with extended cable length.

CameraLink standard is based on Channel Link Technology of National Semiconductor. Channel Link is the standard and advanced concept of LVDS (Low Voltage Differential Signaling) technology for transmitting digital data. Channel Link uses a parallel-to-serial transmitter and a serial-to-parallel receiver to transmit data at rates up to 2.38 Gbps.

## 1.2 Features

- 2/3" Progressive Scan and interline transfer CCD Imager
- 1392(H) x 1040(V) effective pixels
- Supports Digital RS-644(LVDS) or Camera Link
- Supports 15fps full pixel and high frame rate up to 60fps as effective 256 lines
- Square pixel
- High sensitive and low smear
- Full frame shutter from 1/15 to 1/6,000 sec
- Supports random shutter
- S/N ratio 50 dB or better
- Asynchronous reset with external shutter control
- 10-bit RS-644/LVDS digital output
- RS-232 external control
- C-mount

## 1.3 Applications

Applications are machine vision, robotic control, inspection, character recognition, medical, biomedical imaging, microscope, traffic control, surveillance, RFID and other scientific & industrial applications.

## 2. Hardware Setup

### 2.1 Contents of the camera packaging

- NET145LA / NET145CL Camera
- Lens cover
- RS-232C Controller Program
- User's Manual

### 2.2 Accessories for setup (option)

#### 2.2.1 RS-644/LVDS Cable or CameraLink Cable

Should be the flexible twisted pair and overall shielded cable.

#### 2.2.2 RS-232 Cable

#### 2.2.3 Power Cable

#### 2.2.4 Power Supply, PS low noise, low ripple and quality stabilized PS may be used.

PS electricity requirement is 12VDC / 1A

#### 2.2.5 Popular frame grabber

Refer to Appendix A (Compliant List)

#### 2.2.6 Lens

C-mount Lens are available at NET GmbH / NET USA, Inc.

### 2.3 External Description

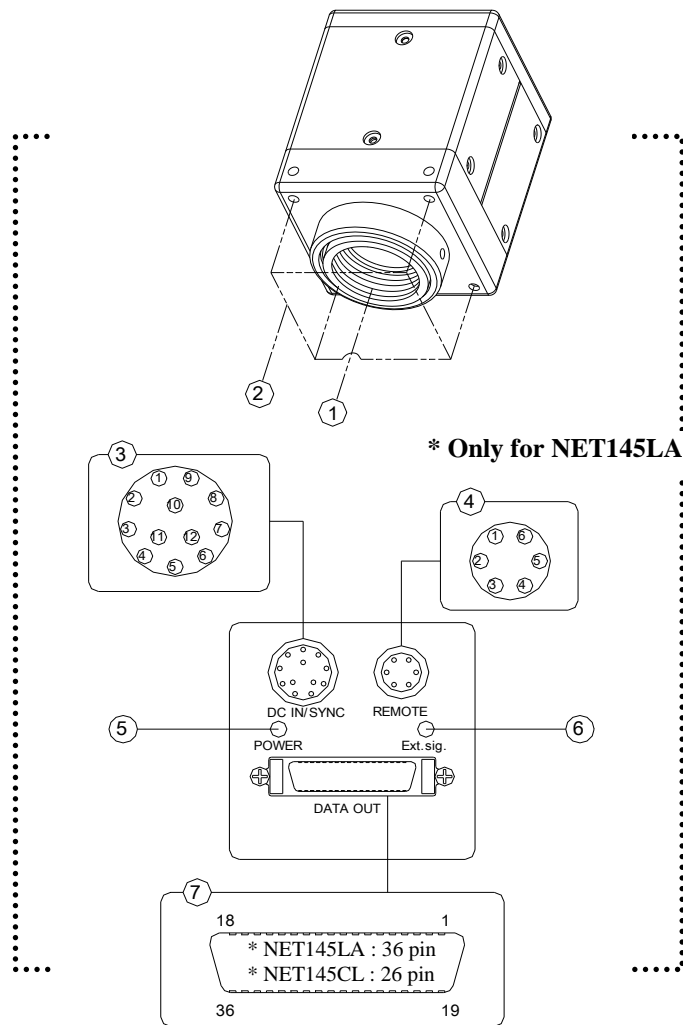


Figure 1. Parts Description

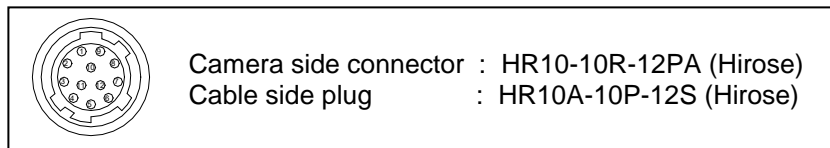


- ◆ Lens mount  
It is suitable for various types of C mount lens.  
C-mount ring can be rotated by loosening the hexagonal screws (M3:Dia 1.5mm)
- ◆ Screw holes for mounting camera  
Used for mounting the camera into a tripod stand, etc.
- ◆ DC Power and Ext. Trigger connector

Pin No.	NET145LA	Pin No.	NET145CL
1	Power GND	1	Power GND
2	+ 12V	2	+ 12V
3	A.GND	3	GND
4	Analog Video Signal	4	NC
5	GND	5	GND
6	External Trigger	6	Rx (RS-232)
7	NC	7	Tx (RS-232)
8	GND	8	GND
9	NC	9	Strobe Pulse
10	GND	10	External Trigger
11	Strobe Pulse	11	NC
12	GND	12	GND

**Figure 2. Power and Trigger Connector**

- Strobe Pulse Signal : Can only be used with Random Shutter mode

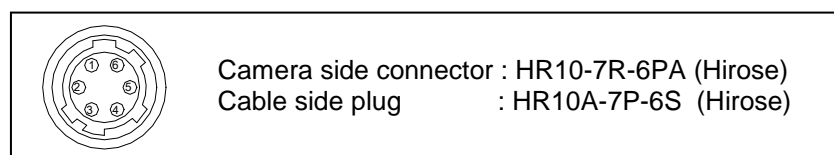


- ◆ Remote and Analog video output connector (Only for NET145LA)  
Below is the connector for 15 Hz non-interlaced video signal of 1 Vp-p with Sync and RS-232C control.

Camera Pin No.	Signal	Signal Name	COM port of PC (DB9)
1	RX	Receive data	3
2	SG	Signal GND	5
3	VIDEO *	-	-
4	+ 10V *	-	-
5	A.GND	Analog GND	-
6	TX	Transmit data	2

**Figure 3. Serial Connector**

- 3 Pin(Video), 4 Pin(+10V), and 5Pin (A.GND) are used for controlling IRIS of Lens, not for RS-232C control

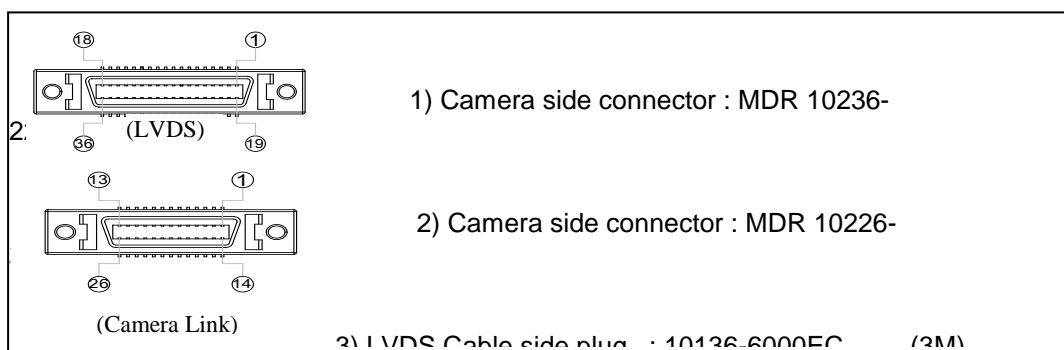


- ◆ Power LED  
When power is on, LED turns blue.
- ◆ External Trigger LED  
When Ext. Trigger enters the LED lights up and under regular Trigger the LED turns green. If red blinks continuously, it indicates an error with the camera or with Ext. Trigger.
- ◆ Digital video data output connector  
Used for connection with the 36-pin interface cable.

Description for NET145LA					
Pin No.	Signal	I/O	Pin No.	Signal	I/O
1	CLK +	O	19	D2 +	O
2	CLK -	O	20	D2 -	O
3	HD +	O	21	D3 +	O
4	HD -	O	22	D3 -	O
5	VD +	O	23	D4 +	O
6	VD -	O	24	D4 -	O
7	RX	I	25	D5 +	O
8	TX	O	26	D5 -	O
9	NC		27	D6 +	O
10	NC		28	D6 -	O
11	NC		29	D7 +	O
12	NC		30	D7 -	O
13	NC		31	D8 +	O
14	EXT TRIG	I	32	D8 -	O
15	D0 +	O	33	D9 +	O
16	D0 -	O	34	D9 -	O
17	D1 +	O	35	GND	
18	D1 -	O	36	GND	

Figure 4. Data Cable Connector

- 1) CLK : Pixel clock output
- 2) HD : Reference timing pulse output for line data
- 3) VD : Reference timing pulse output for frame
- 4) EXT TRIG : Random shutter trigger input



Description for NET145CL					
Pin No.	Signal	I/O	Pin No.	Signal	I/O
1	GND		14	GND	
2	TX0-		15	TX0+	
3	TX1-		16	TX1+	
4	TX2-		17	TX2+	
5	TxCk-		18	TxCk+	
6	TX3-		19	TX3+	
7	SerTC+		20	SerTC-	
8	SerTFG-		21	SerTFG+	
9	CC1-		22	CC1+	
10	NC		23	NC	
11	NC		24	NC	
12	NC		25	NC	
13	GND		26	GND	

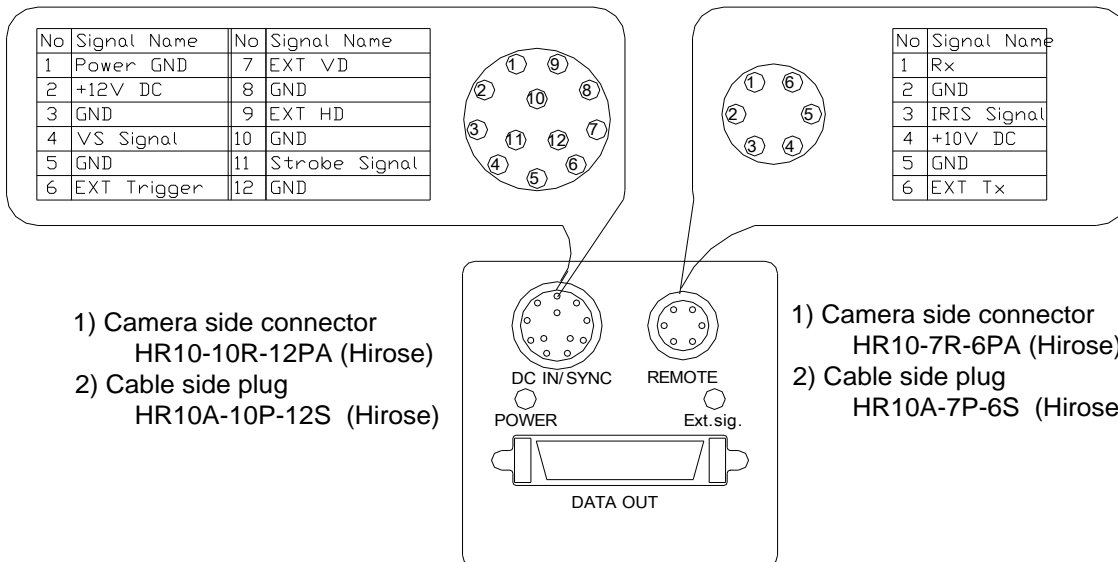
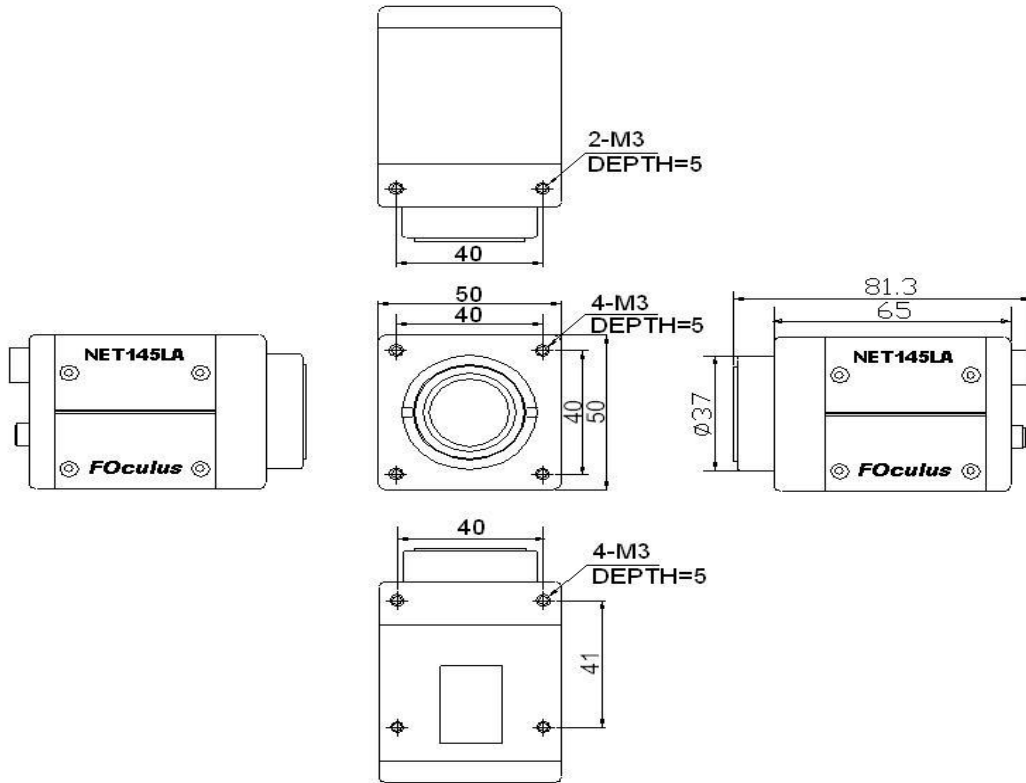
◆ Normal Shutter Speed Mode & Random Shutter Speed Mode

Normal Shutter Speed	Random Shutter Speed
1/15sec	1/120sec
1/30sec	1/250sec
1/60sec	1/500sec
1/120sec	1/1000sec
1/500sec	1/2000sec
1/1000sec	1/3000sec
1/2000sec	1/4000sec
1/3000sec	1/8000sec
1/4000sec	1/16000sec
1/8000sec	
1/16000sec	

Figure 5. Shutter Speed

## 2.4 Dimensions

- Size : 50 (W) x 50 (H) x 76 (L) mm
- Weight : approx. 330gr



## 2.5 Imager Spectral Sensitivity Characteristics

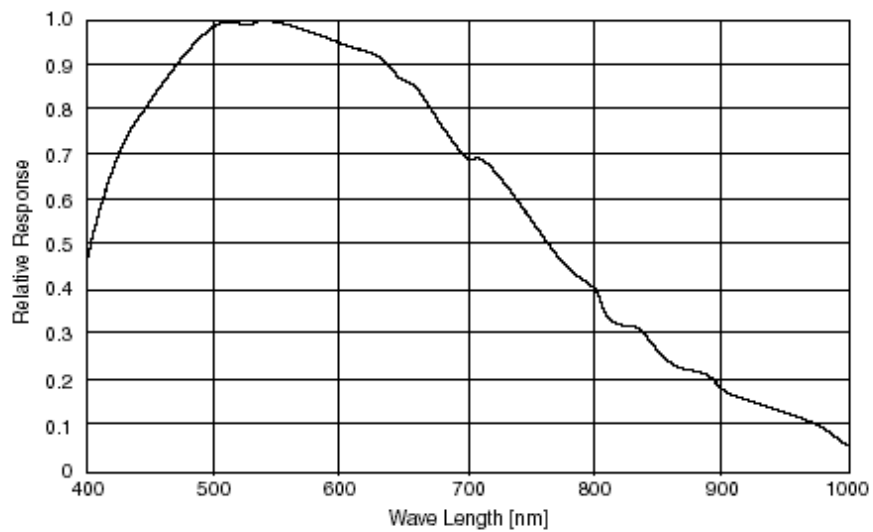


Figure 6. Imager Spectral Sensitivity Characteristics

## 2.6 Setup

### 2.6.1 Setup Configuration

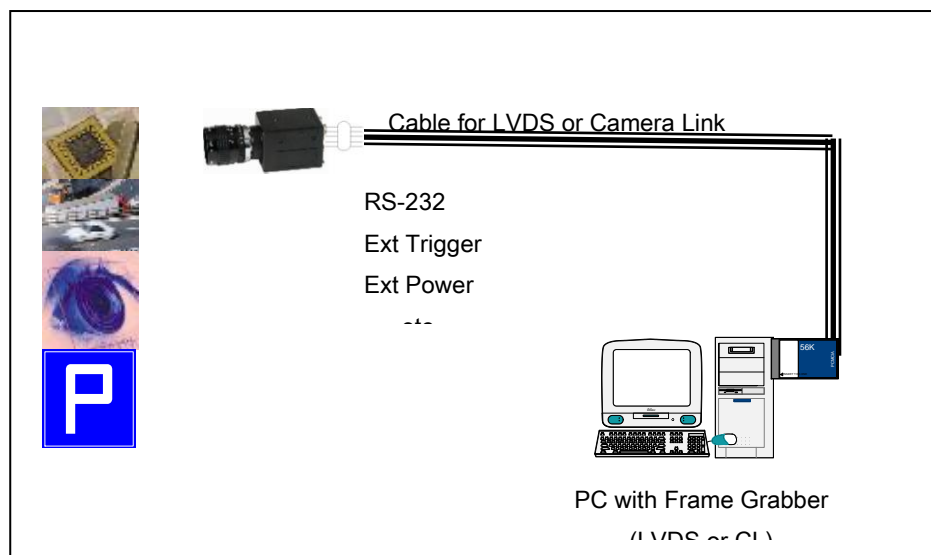
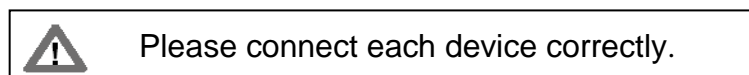


Figure 7. System Configuration

### 2.6.2 Camera setup

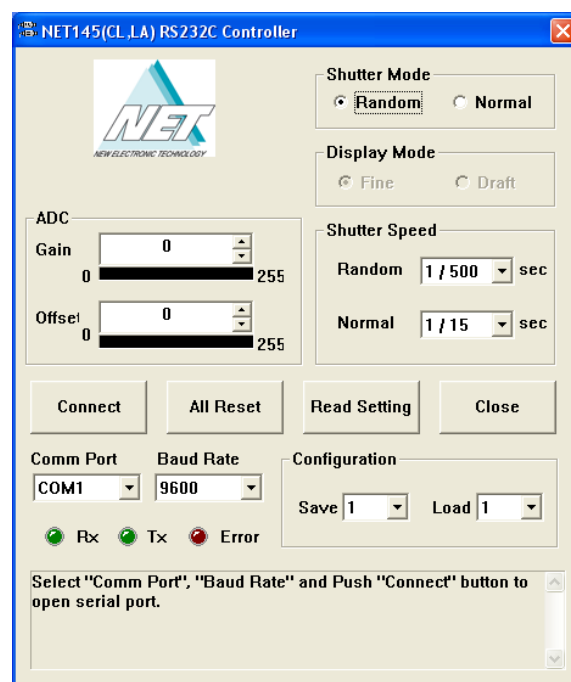


**Cable connection procedure should be in the following order.  
When Plug-off, the step should be reversed !**

- 1) Connect one end of the data cable from FG on PC to camera connector.
  - 1-1) Indicates the connector for outputting digital video signal
  - 1-2) Read out 10-bit parallel signal according to EIA-644 or RS-422 specifications.
- 2) Connect serial cable(RS-232C) from COM Port on PC to camera connector.  
(only used in case of NET145LA)
- 3) Connect one end of the power cable from power supply to camera connector.
  - 3-1) Supply +12VDC power from the external DC power.
  - 3-2) For the power supply voltage, supply the rated 12VDC. If it fluctuates, be sure to use the voltage within the range 10VDC to 15VDC.

### 2.6.3 Installation for RS-232 Control Program

- 1) Make any folder (ex: NET145) on your PC
- 2) Copy the RS-232 control program to your PC  
This should correspond to the appearance figure shown below
- 3) Program may be different according to the camera model
- 4) Run the RS-232 Control Program
- 5) Evaluate the serial communication, shutter speed, mode setting, etc.  
(Refer to the Serial Command List)



## 3. Camera Functions

### 3.1 Shutter

There are two modes in shutter mode such as normal mode and random mode.

#### 3.1.1 Normal Shutter Mode

When the normal shutter is chosen, the CCD performs continuous exposure and outputs the output video signal at real-time. Under this mode, Trigger signal is not accepted.

#### 3.1.2 Random Shutter Mode

When input the external trigger signal, the CCD device charges and outputs rapidly the remained electrical charge area and smear at CCD transfer area.

#### 3.1.3 Shutter Function

The following trigger signal is not accepted within the video accumulation period after trigger input (about 100ms after trigger is signaled).

### 3.2 Vertical Sync Reset

Vertical Sync Reset is only effective in Random Shutter Mode.

#### 3.2.1 When reset

After the trigger signal input, the VD is automatically reset inside the camera. In this case, the input of the EXT VD is not accepted.

### 3.3 Trigger TTL / Trigger LVDS

As described in section "Camera connectors" the cameras are equipped with two equivalent trigger inputs. Pin 8 and 9 of the control interface utilize an opto-coupled TTL input (TR-/+), while pin 2 and 3 of the image data interface make up an LVDS-based trigger input. Normally, the latter is used. It is controlled via a frame grabber, which in turn, obtains the trigger pulse from an external device (for instance a light barrier).

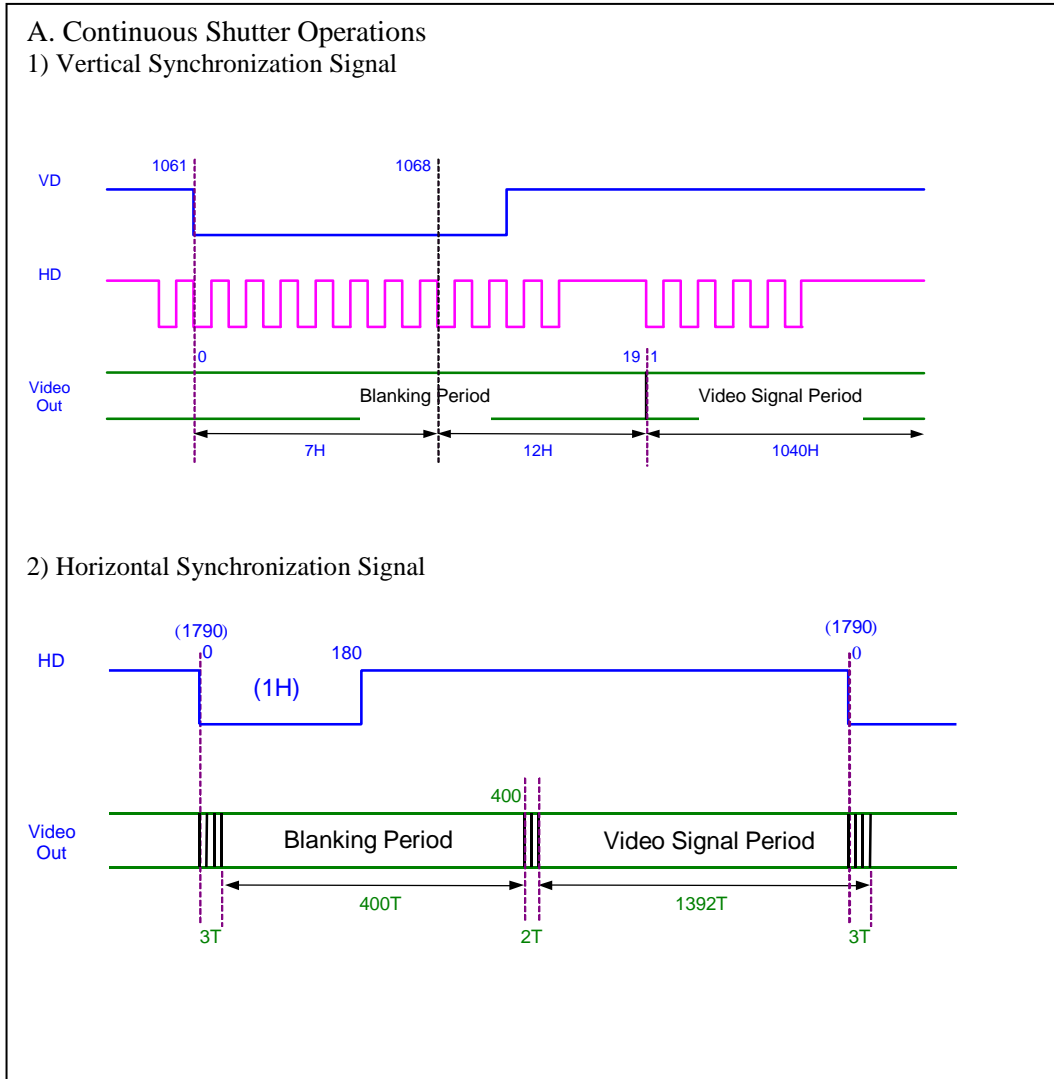
### 3.4 Save to EEPROM

Saves the current camera parameters to Camera's EEPROM.

## 4. Digital and Functional Timing

The image data interface of NET145LA / NET145CL is LVDS or CameraLink based.

The diagram below illustrates the transfer scheme of pixels, lines and frames. Please note that the micro timing may differ from this scheme (signal delay, flank conductance, etc.). Nevertheless, when it comes to the adaptation of a frame grabber to the camera, the micro timing is usually not important. The scheme is conceptually simple: The transfer of an image starts when FVAL(VD) goes low. During this time, LVAL(VD) goes from high to low, thus indicating the transfer of the n-th line. A corresponding low level of PLLK will then signal a valid pixel. Please note that the first and the last pixel of a line, as well as the first and last lines of a frame are black.





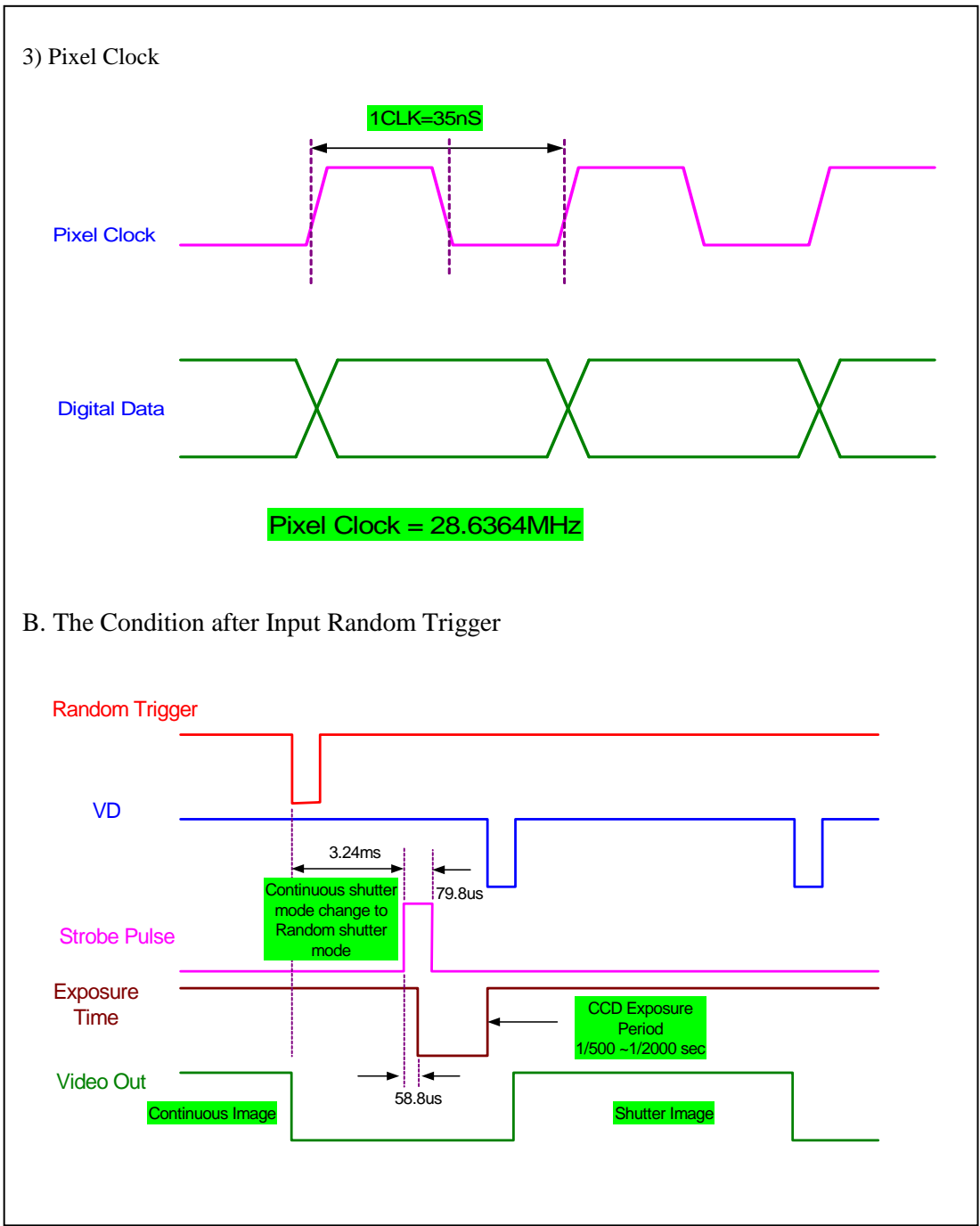


Figure 8. Digital Interface Timing

## 5. Serial Protocol and Command

### 5-1 Protocol

- Communication mode : Transmit by Full duplex serial
- Data length : 8 bits
- Stop bit : 1 bit
- Parity : None
- Transmission speed : 9600 bps
- Refer to Figure3 Serial Connector about cable connection

### 5.2 Command

#### 5.2.1 Command Format

Command is transferred in the following order..

[STX][CODE1][CODE2][TYPE][DATA1][DATA 2][ETX]

In the case of NET145LA,

STX = '\002', ETX = '\003', ACK = '\006', NACK = '\025'

In the case of NET145CL,

STX = 'Z', ETX = 'M', ACK = '\006', NACK = '\025'

Characters	Type	Command	Remark
1st character	STX	-	Start of Command
2 <sup>nd</sup> & 3rd character	CODE	00 ~ FF	Command name
5 <sup>th</sup> and 6th character	DATA	00 ~ FF	Data Value
Last character	ETX	-	End of Command

- It is necessary to provide a text start character control code "STX" at the beginning of each command, and a text end character control code "ETX" at the end.
- All the alphabetic characters of each command should be in capital letters.  
Use of lower case characters does not cause the command to be executed.
- All Commands should be converted to ASCII characters before sending to the camera.
- In case of transmission of an incorrect command or in the event of a communication error, a negative acknowledge character code "NAK" will be sent back from the camera.

## 5.2.2 Command List

Control Item	Command			Description
	CODE	TYPE		
R_SHUT_SPEED	05	0	-	1/120sec
	05	1	-	1/250sec
	05	2	-	1/500sec
	05	3	-	1/1000sec
	05	4	-	1/2000sec
	05	5	-	1/3000sec
	05	6	-	1/4000sec
	05	7	-	1/8000sec
N_SHUT_SPEED	04	0	-	1/15sec
	04	1	-	1/30sec
	04	2	-	1/60sec
	04	3	-	1/120sec
	04	4	-	1/500sec
	04	5	-	1/1000sec
	04	6	-	1/2000sec
	04	7	-	1/3000sec
	04	8	-	1/4000sec
04	9	-	1/8000sec	
GAIN	06	0	XX	ADC gain control (00 : 0dB, FF:+24dB) (* default : 64) XX = 0x00 ~ 0xFF)
Fine/Draft mode	0E	0	-	Fine mode resolution (normal shutter mode only)
	0E	1	-	Draft mode resolution
Shutter mode	0F	0	-	Normal shutter mode
	0F	1	-	Random shutter mode
OFFSET	13	0	XX	ADC Offset control with value xx, XX=0x00~0xFF
	13	1	-	ADC PED control, back to factory setting
ALL RESET	14	F	-	Factory setting
TX Clock	1C	0	-	Tx clock phase 0
	1C	1	-	Tx clock shift by degree of 180
SAVE	F0	0	Y	- Saves the current setting value in [Y] areas of flashrom.
LOAD	F0	1	Y	- Load [Y] area value of flashrom - Y = 0~ F
RETUTN	01	F	-	Transfer the current camera setting value to the serial port.

Figure 9. Serial Command List

- After booting, the camera sets data of [0].

## 5.3 Command Description

### (1) R\_SHUT\_SPEED

Controls Random shutter speed

Example : When sets Random shutter speed to 1/120 sec

NET145LA : \002050\003

NET145CL : Z050M

(2) N\_SHUT\_SPEED  
Controls Normal shutter speed

(3) GAIN  
Gain can be set for the range value from 0 dB to +24 dB.  
To set Gain value to +24 dB

[STX] [0] [6] [0] [F] [F] [ETX]

(4) OFFSET  
The following are the control method for offset value

◆ Offset Setting

[STX] [1] [3] [0] [X] [X] [ETX]  
[X] [X] :[0] [0] ~ [F] [F]

◆ When sets at initial factory default

[STX] [1] [3][1] [ETX]

(5) ALL RESET  
All setting condition initialized.

[STX] [1] [4] [F] [EXT]

By this command, all setting conditions return to initial setting condition. Initial setting condition means Factory setting condition.

(6) SAVE/ LOAD  
Available memorized and call preset setting condition.  
This command can memorize camera setting condition (max.6 modes) and possible to call.

◆ The memory to Page-1 present setting condition

[STX] [F] [0] [0] [1] [ETX]

◆ When call Page-2 (memorized setting condition)

[STX] [F] [0] [1] [1] [ETX]

(7) RETURN  
The current camera setup data is sent from the camera to the terminal.

A. Sending the setup data back to the camera.

[STX] [0] [1] [F] [ETX]

When the above command is accepted by the camera, the following command will be transmitted continuously.

01F[ACK]05Y[ACK]04Y[ACK]06YY[ACK]0FX[ACK]130YY[ACK]

- [ACK] : Acknowledge control code
- X value is 0 or 1 and Y value is from 0 to 0xF

## 5.4 Data Transmit and Receive

### 5.4.1 Transmission and Reception

- (1) The following shows how the data is normally transmitted from the terminal and received by the camera.  
The command normally received by the camera is added with an acknowledgement control code "ACK" and sent back to the terminal.

Example : N\_SHUT\_SPEED command is transmitted.

- [STX 0 A 1 ETX] is transmitted from the terminal.
- N\_SHUT\_SPEED switch of the camera is set to on.
- [0 4 1 ACK] is sent from the camera back to the terminal

- (2) In case in which an incorrect command (a command not covered in the list) is transmitted from the terminal  
A negative acknowledge control code [NAK] is sent from the camera back to the terminal.
- (3) Other errors  
In the event that a command fails to be accepted due to occurrence of a communication error, [NAK] is also sent back.

## 6. Frame Grabber Setup

### 6.1 Meteor-II/DIG (for NET145LA)

The bandwidth of the Meteor-II/Digital is not sufficient for the full speed mode of NET145LA. All the other cameras may be used in **Full Speed** mode.  
Please note that the Meteor-II/DIG works with Windows NT/2000/XP.

#### 6.1.1 FG Installation

Please install the frame grabber Meteor-II/DIG first.  
(The details of this installation are described in chapter 2 and 3 of Hardware Installation and Installing Software of the grabbers manual.)

#### 6.1.2 DCF Copying

Depending on the type of camera in use, you will find a CD named FOControl shipped with camera. CD contains DCF file for the adaptation of the Meteor-II/DIG to NET145LA/NET145CL. Please copy the file to a hard disk directory of your choice.

#### 6.1.3 Start Intellicam

Start the program Matrox **Intellicam**, to be installed with the grabber.

Please make sure that in the middle of the toolbar, **MeteorII Digital Device 0 should be chosen and displayed, which means MeteorII Digital Device 0 under the folder of MeteorII Dig of System Delection**

#### 6.1.4 Start DCF

Exit **Intellicam** first and then start the DCF file.

#### 6.1.5 Continuous Grab

Click **Continuous Grab**.

Window shows the free running image of the camera.

## 6.2 Different Frame Grabber

NET145LA / NET145CL can be used with other digital frame grabbers as well. However, please note that the implementation of the cable as well as the adaptation of the frame grabber requires some experience.

## 7. Camera Specification

Features	NET145CL	NET145LA
Image Device	2/3" CCD Sony ICX285AL	
Effective pixel	1.450.000 pixel 1392(H) x 1040(V)	
Pixel Size	6.45 $\mu\text{m}$ x 6.45 $\mu\text{m}$	
Image Area	10.2 (H) x 8.30 (V) mm	
Scanning System	Progressive Scan	
Frame Rate	15fps full pixel read out	
Shutter Speed	20 $\mu\text{s}$ – 66ms	
Aspect Ratio	4 : 3	
Lens Mount	C-mount	
Flange Focal Distance	17.526mm	
Digital Interface	Camera Link, RS-232C	EIA-644 (LVDS) or RS-422, RS232C
Gain Control	Auto or Manual	
Synchronization	External Trigger	
Gamma	1	
Min. Illumination	0.5lux @ F 1.4	
S/N Ratio	50 dB or better	
Power Supply	12VDC	
Power Consumption	500mA	
Weight	approx. 330 gr.	
External Dimensions	50 (W) x 50 (H) x 76 (D) mm	
Operation Temp.	-10 to + 50 °C, 20 – 90% rel., non cond. Humidity	
Storage Temp.	-20 to + 60 °C, 20 – 70% rel., non cond. Humidity	

Figure 10. Camera Specifications

## 8. Troubleshooting

The following information can help solving problems that may occur during the setup of the camera. Make sure that the camera is part of the entire acquisition system

- Power supplies
- Frame grabbers H/W and S/W
- Light source
- Operation environment
- Cabling
- Host computer
- Optics

### 8.1 Common Solutions

The first step during troubleshooting is to verify that the camera has all the correct connections regarding Power supply, Data cables, etc.

## 9. Technical Support Information

If you need technical assistance, please do not hesitate to contact NET GmbH Technical Support

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## Appendix A. Compliant FG List

Manufacturer	Model	Remark
Mutech Corp	MV1500	
Coreco Imaging	X64-CL	
Euresys	Multi	
Matrox Imaging	Meteor-II / Digital	
National Instruments	IMAQ-1422	
National Instruments	IMAQ-1424	

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