

# Gx Camera Ethernet Adapter



## User's Guide



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# Introduction

Gx Camera Ethernet Adapter allows connection of Gx series cameras (models G0 to G4) to the control computer using Ethernet interface and TCP/IP protocol stack (this means over Local or Wide Area Networks).

Gx series of CCD cameras are equipped with USB 2.0 interface with 480 Mbps transfer speed. USB interface brings numerous advantages beside the very high transfer speed. For instance USB connectors and cables contain also lines dedicated to provide power to attached devices, so the G0 and G1 cameras are connected to the host computer only by single cable (power requirement of the cooled CCD cameras of G2, G3 and G4 series is significantly greater than the USB line can provide and these cameras use their own power supply). USB cables are standardized, which is why they cannot be confused and plugged the wrong way etc. Also software support of USB devices is designed from the ground up to provide “Plug-and-Play” experience. Users need not to perform any device configuration, assign unique addresses etc.

A disadvantage of USB connection is the limited distance between a host PC and USB device. The maximum length of single USB cable is limited to 5 meters. This distance can be prolonged to 10 or 15 meters with the help of so-called Active USB Extenders, but a cable connection and active USB repeater (hub) must be placed every 5 meters. Very long USB connections can be also power-limited. The energy, provided by the host PC, is consumed by active repeaters and also long power lines with non-zero electrical resistance cause drop of supply voltage.

The problem of connection of Gx CCD cameras over a long distance is solved by Gx Camera Ethernet Adapter, offering remote camera connection over Ethernet interface. The core of the adapter is an embedded computer with a software on the local Flash drive.

Three models of Gx Camera Ethernet Adapters are available:

- The largest “standard” variant uses a PC-compatible motherboard equipped with the Intel Atom processor. No moving parts are present in the device, the processor needs no fan and is cooled only passively.

This variant is powered by single 12 V DC line, the same like the G2, G3 and G4 cameras. Also power line connectors are the same, so the device can be powered like the rest of the setup.

- Medium variant of the Gx Camera Ethernet Adapter called “mini” is also based on the PC-compatible motherboard, but a smaller one called NUC (an abbreviation from Next Unit of Computing). These motherboards can have higher computational power and thus also higher TDP, so they can be equipped with a small cooling fan. Mini-variant of the adapter is powered from 19 V DC adapter (similarly to many laptop and notebook computers), supplied with the device.
- The smallest “micro” variant of the Gx Camera Ethernet Adapter is based on the ARM architecture. It is powered from a single 12 V DC line, like the standard variant (and like all G2, G3 and G4 cameras).



*Illustration 1: Micro (left), Mini (center) and Standard (right) variants of the Gx Camera Ethernet Adapter devices*

All three variants use Ethernet interface supporting both 1 Gbps and slower 10/100 Mbps transfer speeds and can be connected to all common local area networks.

Single Gx Camera Ethernet Adapter contains four USB 2.0 ports and allows connection of up to four Gx cameras at the same time (regardless of the specific series, cameras can be freely combined). Of course if more digital cameras share single Ethernet interface, number of transferred frames per second is lower. Real transfer speed depends also on other factors, like Ethernet interface

transfer speed (1 Gbps or 100 Mbps) and network infrastructure (switches, routers etc.). If the 1 Gbps interface is used, the difference between download time of directly connected camera and camera connected over the Gx Camera Ethernet Adapter is negligible.



*Illustration 2: Despite differences in mechanical construction, function and usage of all variants are identical*

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# Handling of the device

## Standard variant

The standard Gx Camera Ethernet Adapter is based on the Mini-ITX standard PC motherboard. It employs low-power Intel Atom processors, so the cooling is only passive.

The device can be powered from direct current power supply 8 to 19 V DC. Power connector is located on the left side of the unit back panel. The connector is standard  $\varnothing 5,5/2,5$  mm. Plus pole is on the inner pin, neutral (ground) pole on the connector outer jacket.



*Illustration 3: Gx Camera Ethernet Adapter back panel*

Universal 12 V DC AC/DC power supply is supplied with the Gx Camera Ethernet Adapter. The supply input voltage is 100-240 V AC/50-60 Hz.

<b>Gx Ethernet Adapter power</b>	8 to 19 V DC
<b>Power consumption</b>	8 W without attached cameras
	16 W with four G1 cameras
<b>Power supply input voltage</b>	100-240 V AC/50-60 Hz
<b>Power supply output voltage</b>	12 V DC/5 A
<b>Power supply power</b>	60 W

Notes:

G2, G3 and G4 cameras use own power supply, so they do not increase Gx Ethernet Adapter power consumption.

The power consumption is measured on the 12 V DC output voltage. The AC/DC power supply itself consumes around 9 W. The consumption on the AC side varies between 17 and 25 W.

Gx Camera Ethernet Adapter is configured to start immediately after power line is connected. However, it can be switched off and on when powered with the ON/OFF button on the device front panel.



*Illustration 4: Gx Camera Ethernet Adapter front panel*



Two more buttons RESET and FACTORY SETTINGS are also on the front panel. RESET reboots the device and FACTORY SETTINGS restores the default parameters (device configuration is described thoroughly in the following chapters).

Gx Camera Ethernet Adapter Standard unit mechanical properties are:

<b>Dimensions</b>	188 × 184 × 40 mm
<b>Weight</b>	0.7 kg

Notes:

Gx Camera Ethernet Adapter is shipped in variant intended for laying of the device on any flat surface. There is also variant intended for hanging of the device on the standard DIN-rail, if the device has to be located inside some distribution box.

The stated height does not include plastic legs or DIN-rail clip.

## Mini variant

The mini-variant of the Gx Camera Ethernet Adapter is based on the NUC (Next Unit of Computing) PC-compatible motherboard. Due to higher computational power, the processor may require active cooling.

The device is powered from 19 V DC power supply. Power connector is located on the side of the unit. The connector is standard  $\varnothing 5,5/2,5$  mm. Plus pole is on the inner pin, neutral (ground) pole on the connector outer jacket.



*Illustration 5: Gx Camera Ethernet Adapter mini-variant side connectors*

Universal 19 V DC/65 W power supply is supplied with the Gx Camera Ethernet Adapter. The supply input voltage is 100-240 V AC/50-60 Hz.

<b>Gx Ethernet Adapter mini power</b>	19 V DC
<b>Power consumption</b>	7 W without attached cameras
	15 W with four G1cameras
<b>Power supply input voltage</b>	100-240 V AC/50-60 Hz
<b>Power supply output voltage</b>	19 V DC/3.4 A

**Notes:**

G2, G3 and G4 cameras use own power supply, so they do not increase Gx Ethernet Adapter power consumption.

The power consumption is measured on the 19 V DC output voltage. The AC/DC power supply itself consumes around 9 W. The consumption on the AC side varies between 16 and 24 W.

Gx Camera Ethernet Adapter is configured to start immediately after power line is connected. However, it can be switched off and on when powered with the ON/OFF button on the device top panel.



*Illustration 6: Buttons on the top side of Gx Camera Ethernet Adapter mini-variant*

Two more buttons RESET and FACTORY SETTINGS are also on the top of the device. RESET reboots the device and FACTORY SETTINGS restores the default parameters (device configuration is described thoroughly in the following chapters).

Gx Camera Ethernet Adapter Mini unit mechanical properties are:

<b>Dimensions</b>	128 × 111 × 50 mm
<b>Weight</b>	0.6 kg

Notes:

Gx Camera Ethernet Adapter is shipped in variant intended for laying of the device on any flat surface or to be attached using four bolts. There is also variant intended for hanging of the device on the standard DIN-rail, if the device has to be located inside some distribution box.

The stated height does not include plastic legs or DIN-rail clip.

## Micro variant

The micro variant of the Gx Camera Ethernet Adapter uses ultra-low-power embedded computer with ARM compatible multi-core processor.

The device can be powered from direct current power supply 10 to 30 V DC. Power connector is located on the side of the unit case. The connector is standard  $\varnothing 5,5/2,5$  mm. Plus pole is on the inner pin, neutral (ground) pole on the connector outer jacket.



*Illustration 7: Gx Camera Ethernet Adapter Micro side panel*

Universal 12 V DC AC/DC power supply is supplied with the Gx Camera Ethernet Adapter Micro. The supply input voltage is 100-240 V AC/50-60 Hz.

<b>Gx Ethernet Adapter power</b>	10 to 30 V DC
<b>Power consumption</b>	2 W without attached cameras 10 W with four G1cameras
<b>Power supply input voltage</b>	100-240 V AC/50-60 Hz
<b>Power supply output voltage</b>	12 V DC/5 A
<b>Power supply power</b>	60 W

Notes:

G2, G3 and G4 cameras use own power supply, so they do not increase Gx Ethernet Adapter power consumption.

The power consumption is measured on the 12 V DC output voltage. The AC/DC power supply itself consumes around 9 W. The consumption on the AC side varies between 11 and 19 W.

Gx Camera Ethernet Adapter is configured to start immediately after power line is connected.



*Illustration 8: Gx Camera Ethernet Adapter Micro top side with buttons*

Two buttons RESET and FACTORY SETTINGS are on the top panel. RESET reboots the device and FACTORY SETTINGS restores the default parameters (device configuration is described thoroughly in the following chapters).

Gx Camera Ethernet Adapter Micro unit mechanical properties are:

<b>Dimensions</b>	95 × 83 × 39 mm
<b>Weight</b>	0.3 kg

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# Device configuration

All Gx Camera Ethernet Adapters are identical from the configuration and usage point of view.

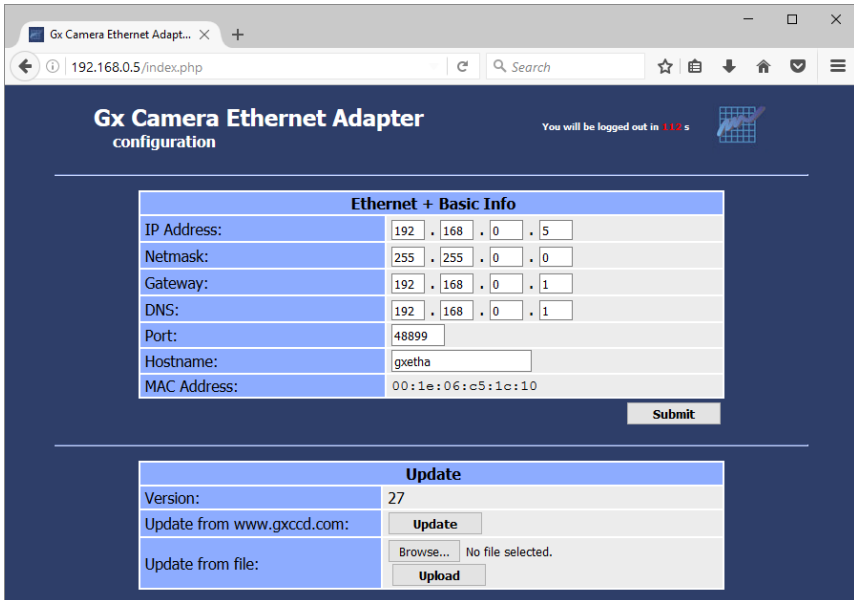
Every device providing services to clients over TCP/IP network must have a fixed IP address assigned to be continuously accessible. Configuration of the Gx Camera Ethernet Adapter network interface (assigning of the IP address, definition of the network mask and default gateway etc.) is performed using WWW interface. When the device is powered for the first time, the following parameters are preset:

<b>IP Address</b>	192.168.0.5
<b>Network mask</b>	255.255.255.0
<b>Gateway</b>	192.168.0.1
<b>DNS server</b>	192.168.0.1
<b>Port</b>	48899

To be able to connect to the device for the first time, it is necessary to attach it to the network with above defined parameters (it is enough to connect the device directly to the computer with properly set network parameters with an Ethernet cable). Then it is possible to connect the device to the desired network after the configuration is updated.

Configuration is performed through WWW interface and any web browser can be used to access it. The WWW configuration interface is not available all the time the device is running, but it is stopped after two minutes from the time the device is powered up from the security reasons. This measure prohibits unwanted configuration changes when the device is accessible from many different computers.

To access Gx Camera Ethernet Adapter configuration, type its IP address into “address” line of the web browser (e.g. <http://192.168.0.5/>). The following page is then displayed:



*Illustration 9: Web-based configuration interface*

Then it is possible to change the device settings. Updated parameters must be confirmed by clicking the „Submit“ button.

If from various reasons the current configuration of the device is not known, it is possible to restore default factory settings. To do this, power up the device while pressing the FACTORY SETTINGS button on the device front panel. It is necessary to keep the button pressed for at least 15 seconds from the time of power on. Then it is possible to configure again the device the same way like upon the first power up (device IP address is set to 192.168.0.5).



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## Using of WiFi connection

The Ethernet port of the adapter device can be attached to arbitrary WiFi bridge device to access attached cameras wirelessly. However, such solution needs another box (the Ethernet/WiFi bridge device) with another power supply etc. This is why the Gx Camera Ethernet Adapter firmware was extended with support for USB/WiFi interfaces.

Note:

The USB/WiFi are supported in device firmware version 28 or higher.

The WiFi adapter can be plugged into any USB port. The Gx Camera Ethernet Adapter then can be added to any existing WiFi network.

Note:

Such adapter occupies one USB port, so using it limits number of connected Gx cameras typically from 4 to 3. This should be still enough for all applications.



*Illustration 10: The USB/WiFi adapter is plugged into one USB port*

Because the WiFi adapter antenna is located outside of the device metal case, the signal reception is better compared to devices employing WiFi adapter with antenna soldered on the electronics circuits board. The USB 2.0 HiSpeed transfer rate 480 Mbps typically do not bottleneck the WiFi transfers, which are usually slower.

Device with attached USB/WiFi adapter has to be configured over a wired Ethernet connection exactly like the standard Gx Camera Ethernet Adapter. However, the configuration page offers the WiFi adapter configuration section.

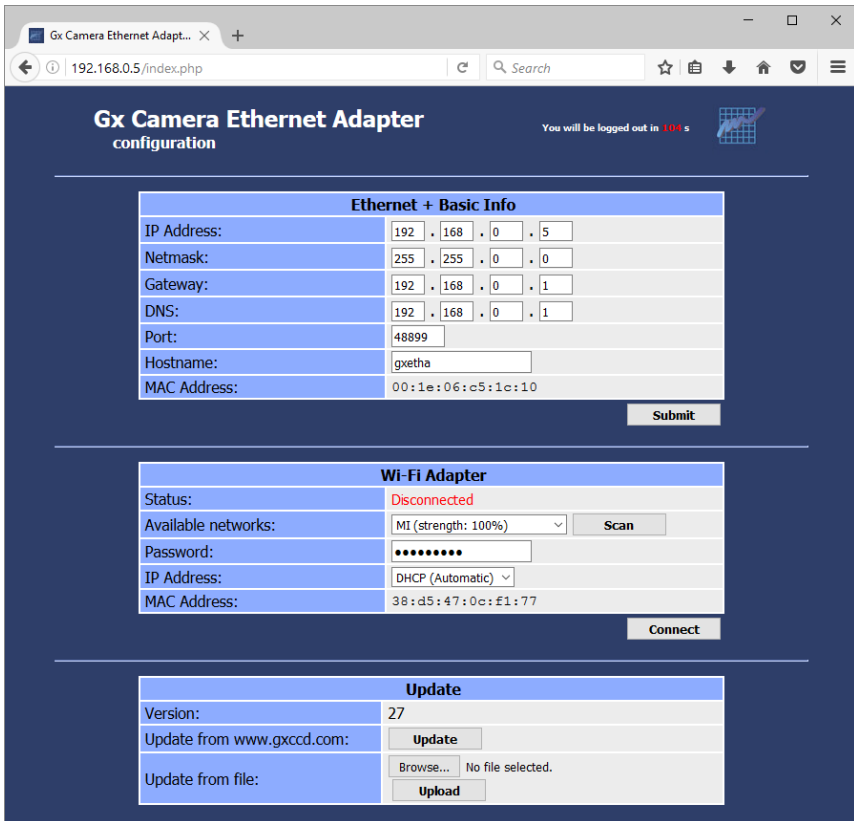


Illustration 11: USB/WiFi adapter configured to obtain IP address dynamically through DHCP

There are two possibilities how to assign the WiFi adapter IP address. The first possibility is to let the DHCP server assign it. Because the Gx Camera Ethernet Adapter is accessed as a server, it is necessary to assign a fixed address to it, so the clients always know the address to which they should connect. It is usually a task of the DHCP server configuration, which allows assigning a particular IP address to the device with defined MAC address.

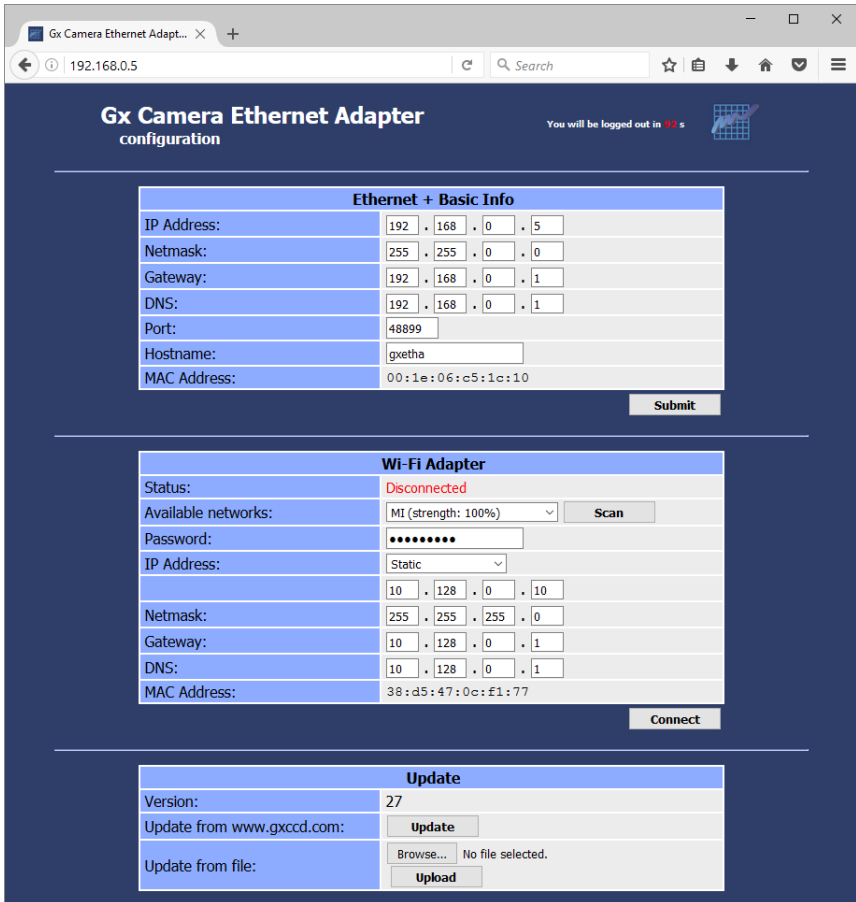
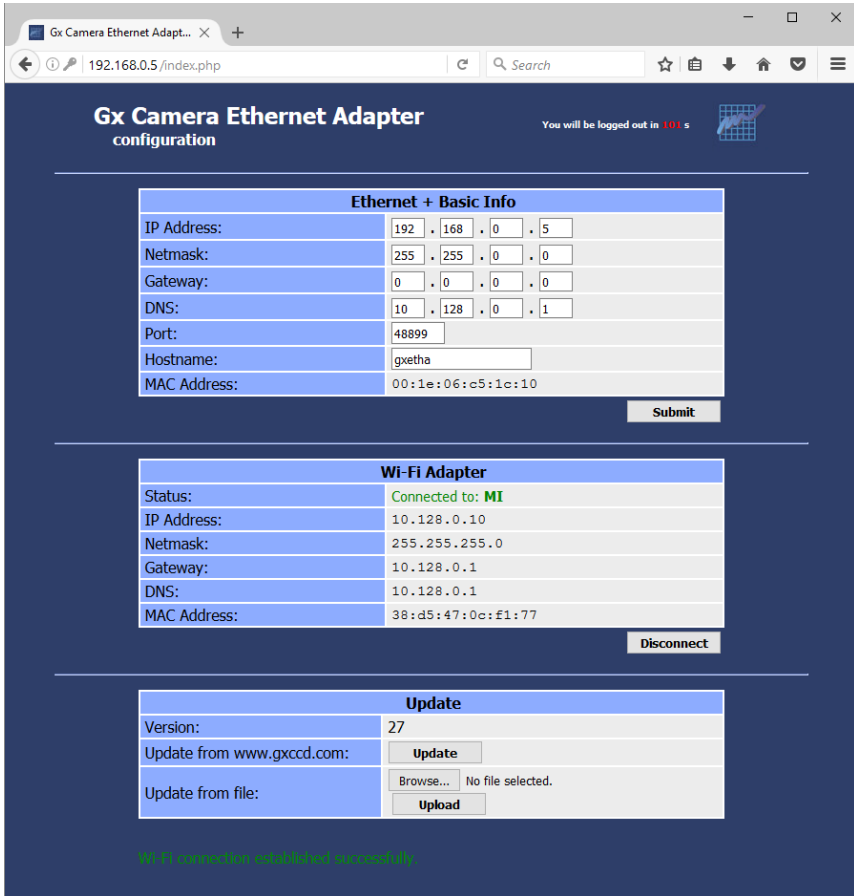


Illustration 12: USB/WiFi adapter with manually configured IP address

Another possibility is to configure the IP address of the Gx Camera Ethernet Adapter manually.



The properly configured USB/WiFi interface can then be connect to WiFi network. The configuration page indicates successful connection.

Note:

When the Gx Camera Ethernet Adapter is reset to initial state, the WiFi network has to be configured again using the wired Ethernet connection.

Currently supported USB/WiFi chipsets are:

- Realtek RTL8192CU/RTL8188CU/RTL8187
  - ASUS USB-N10 Nano, USB-N13
  - D-Link DWA-121, DWA-131, DWA-135
  - TP-LINK TL-WN82xN
  - Netgear N150, N300
  - Belkin Surf USB Micro
- Ralink/MediaTek RT257x/RT2671/RT2770/RT2870/RT307x/RT3572
  - ASUS USB-N13, USB-N14, USB-N66, USB-N53
  - Linksys AE3000
  - Netgear WNDA4100
  - ZyXEL N220
  - D-Link DWA-137, DWA-140, DWA-160, DWA-162
- Atheros AR5007UG/AR2524/AR5523/AR5524/AR7010/AR9271
  - Netgear WNA1100
  - TP-LINK TL-WN72xN
  - D-Link DWA-126
- Atmel AT76C50x
- Broadcom BCM43143/BCM43242/4320
- Marvell 88W8388/88W8797

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# Camera connection

Single Gx Camera Ethernet Adapter can attach up to four G0 to G4 cameras to the control PC using the Ethernet interface. It is worth noting that the device is not an ordinary USB/Ethernet converter, just tunneling USB data over the TCP/IP network (such converters usually do not work properly with all devices and their usage brings numerous problems and is not reliable). The Gx Camera Ethernet Adapter handles attached Gx cameras the same way like the host PC, there is no difference from the camera point of view in command sequences and especially timing, transfer speeds etc.

Quite opposite situation is on the control PC. There are fundamental differences between the camera connected directly to the USB port and the camera connected through the Gx Camera Ethernet Adapter. Cameras behave like two totally different and incompatible devices – the USB interface is used in the first case, TCP/IP network sockets interface in the second case (Gx camera and the Gx Ethernet Adapter behaves like a single device).

No USB device system drivers are to be installed on the control PC in the second case (and also system drivers for any other device are not installed), USB interface is not used to communicate with camera at all. The control computer communicates with the camera using the TCP/IP protocol only.

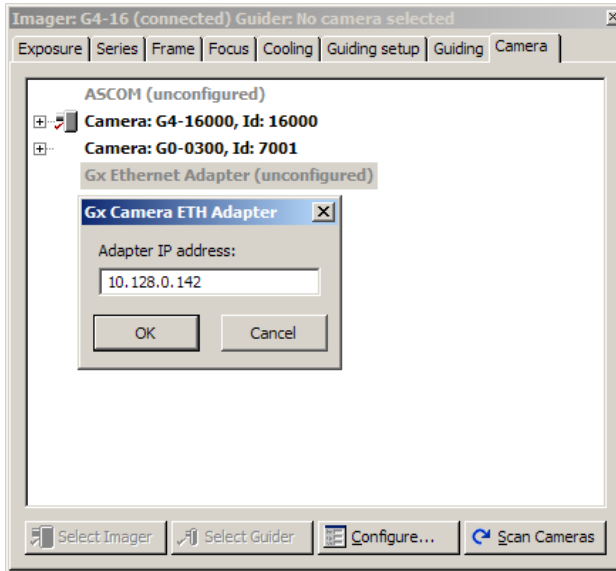
This is also why drivers for client programs (SIPS, ASCOM, MaxIm DL, ...) are also different and a driver intended for camera connected to USB does not work with camera connected over Ethernet.

Let us note that unlike USB, the Ethernet interface (and TCP/IP network) is not designed to be “Plug-and-play”. If the connection to different computer (server) is to be established, its IP address or domain name must be known. So even before the control computer can connect to the Gx Camera Ethernet Adapter, the IP address or domain name of the particular device must be defined.

For instance every attached USB camera is immediately displayed in the SIPS (Scientific Image Processing System) software Camera configuration tool window and the user may choose the camera as imager or guider. And when no

USB camera is connected, SIPS does not offer such cameras despite the camera driver is present and active.

On the other hand, cameras with Ethernet interface require the possibility to configure the IP address or domain name. This is why when the driver for cameras connected over the Ethernet is present in the SIPS, the software always displays a line “Gx Ethernet Adapter”, marked as “unconfigured”. When this line is selected, it is possible to open a dialog box allowing definition of IP address or domain name by clicking the “Configure” button.



Other programs may offer different ways to configure (define the IP address) the Gx Camera Ethernet Adapter.

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# Firmware update

The Gx Camera Ethernet Adapter handles connected cameras directly and independently on the control computer and also provides various resources to connected cameras – for instance a temporary memory for the whole frames of all connected cameras, because the Ethernet interface is unable to ensure uninterrupted transfer of images to the control computer. So the firmware of the Ethernet adapter device is quite complex and it must be adopted to every new camera model. This is why two convenient ways to update the Gx Camera Ethernet Adapter firmware was built in.

## Manual update from the PC

The firmware can be updated using the configuration WWW interface, also used to define device network configuration. The same limitation (the WWW configuration interface is accessible only for the first two minutes after power on, it is then stopped from security reasons) applies here, too.

This way of firmware update supposes that the user already has a binary file with a new version of the Gx Camera Ethernet Adapter firmware, for instance downloaded from <http://www.gxccd.com/> web server. Then it is enough to select proper file by clicking the “Browse” button in the „Update from file:“ section and then send the file to the device by clicking the „Upload“ button.

Keep on mind that different Gx Camera Ethernet Adapter variants use processors of different architecture, which are not mutually compatible.

- Standard and Mini variants are based on the Intel architecture (x86).
- Micro variant uses ARM based processor.

It is necessary to choose proper firmware version only when updating the firmware manually. Automatic update selects proper firmware without user's intervention.



## Automatic update

Another way to update the firmware lets the Gx Camera Ethernet Adapter itself to download the binary file directly from the <http://www.gxcd.com/> web site. It requires the device to be connected to the Internet and the valid DNS server address must be defined in device configuration. The device configuration WWW interface is used again, but it is enough to click the „Update“ button and the device performs the update. If no DNS server is available, it is possible to use for instance IP address 8.8.8.8 of the Google Public DNS.