Technical Details

Industrial Cameras: CCD - 21, 31, 41 and 51 Series - Trigger and I/O

THE IMAGINGSOURCE
TECHNOLOGY BASED ON STANDARDS

Content

Introduction

In addition to a number of other applications, The Imaging Source USB, FireWire and GigE CCD cameras are also used for industrial purposes. Most of these applications require a trigger input and general purpose digital I/Os. These features are provided by all USB cameras whose product code contains a "BU" (e.g. DMK 21BU04, DFK 41BU02.H, etc.), all FireWire cameras whose product code contains a "BF" (e.g. DMK 31BF03-Z, DBK 41BF02, etc.) and all GigE cameras whose product code contains a "BG" (e.g. DMK 21BG04, DBK 41BG02.H, etc.).

The trigger input of all these cameras is available via a BNC connector and thus very easy to access. The access of the digital I/Os depends very much on the application. Therefore, basically all USB and FireWire cameras offer a pin header that can be accessed through a hole in the cameras backplane. Please note: GigE cameras do not provide this pin header.

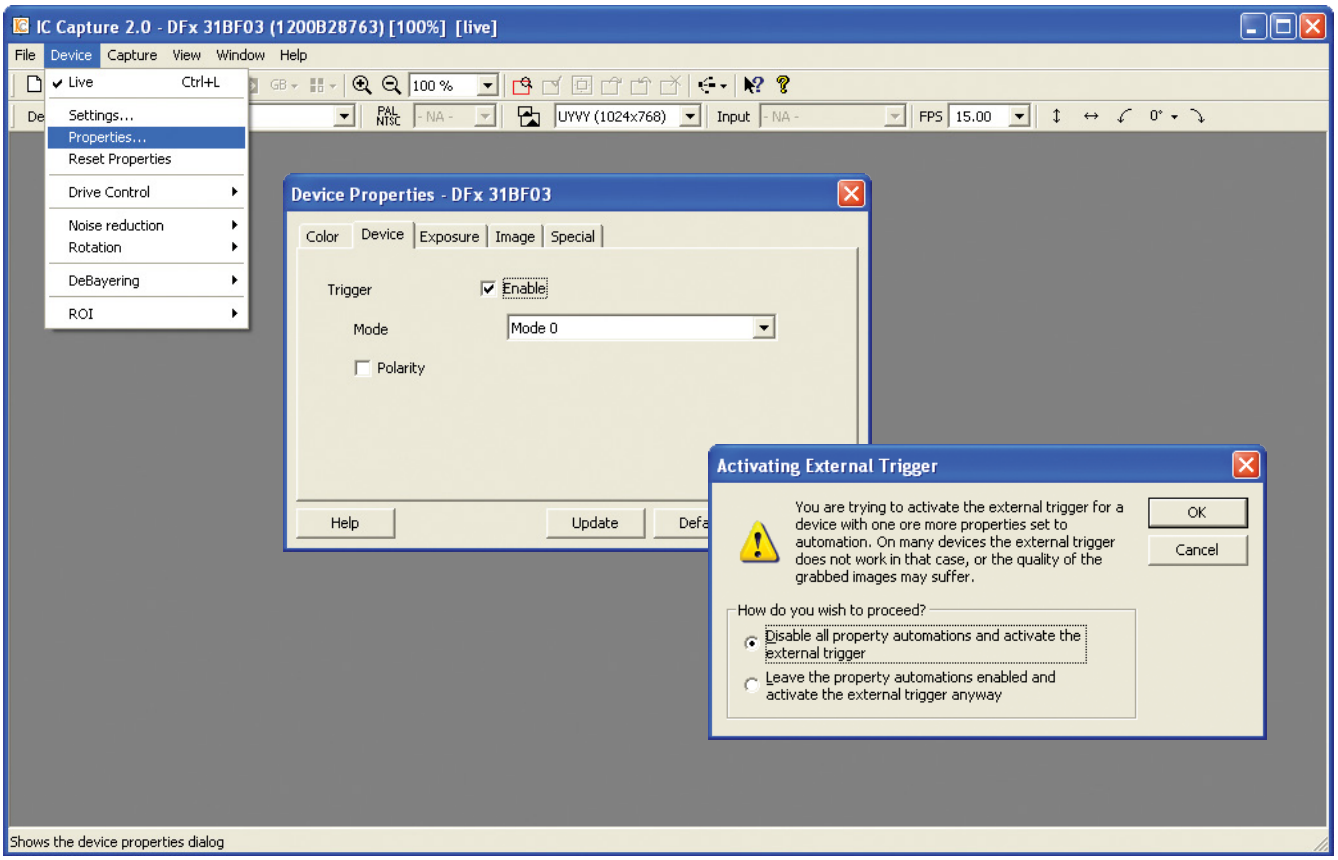
For all users who prefer to access the digital I/Os using an external connector, The Imaging Source offers cameras with a 12-pin Hirose connector on the camera's backplane. The product code of these cameras ends with the suffix ".H" (e.g. DMK 21BU04.H, DFK 41BF02.H, DBK 31BG03.H, etc.).

This manual describes the use of all The Imaging Source USB, FireWire and GigE CCD cameras that provide an external trigger in addition to digital I/Os.

Getting started

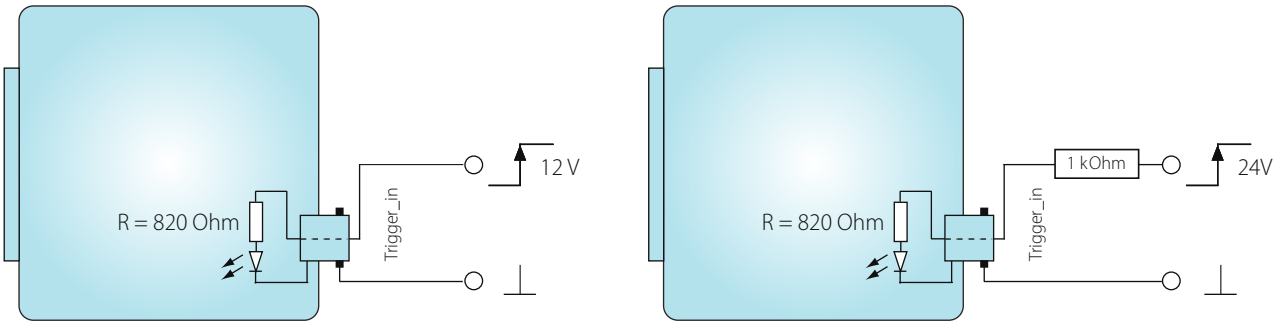
The following steps describe the use of the most commonly used digital input - the trigger input:

- Setup the camera as described in the Getting Started document that accompanies the camera.
- Install the software IC Capture as described in the Getting Started document.
- Make sure that the camera works correctly with IC Capture.
- Connect a trigger source that creates a positive pulse to the cameras BNC connector as shown at the right hand side. The height of the pulse may lie between 3.3 and 12 V.
- Enable the trigger mode by clicking
  Device > Properties... > Device > Enable (please see the images below).
  If you see the dialog Activation External Trigger, please click "Disable all property automations..." Then, please set all camera parameters according to the requirements of your application. Please find these parameters in the Device Properties dialog (Device > Properties...):



Trigger input - hardware and timing

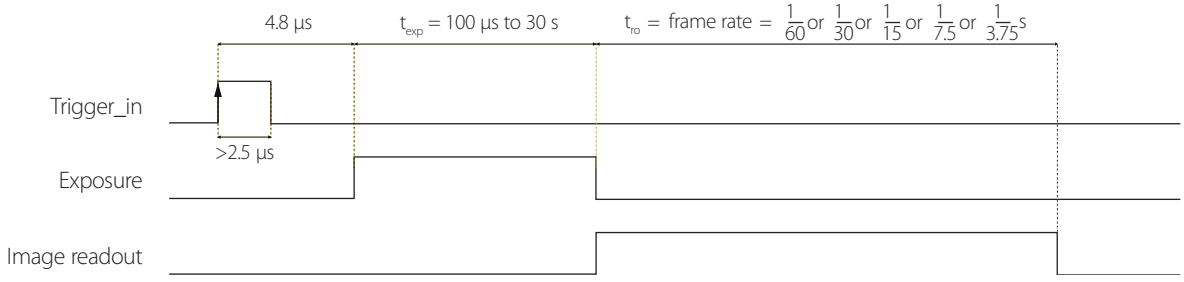
The trigger input of The Imaging Source USB, FireWire and GigE CCD cameras is opto-coupled. It permits positive trigger pulses with any amplitude between 3.3 and 12 V (24 V using a series resistance of 1 kOhm). If you intend to apply higher pulses please make sure that the current lies between the limits of 3 to 12 mA.



The Imaging Source USB, FireWire and GigE CCD cameras offers two different modes of operation:

Free running: The cameras generate a stream of up to 60 images/s depending on their resolution. To considerably reduce the amount of data, the frame rate may be reduced to 30, 15, 7.5 or 3.75 images/s. The exposures length can be set in the range of 100 µs to 30 s via software. Please note, however, that the camera's clock generator determines the actual moment of exposure. Thus, it cannot be controlled externally, but measurable using the strobe output. Therefore, this mode of operation is called "free running".

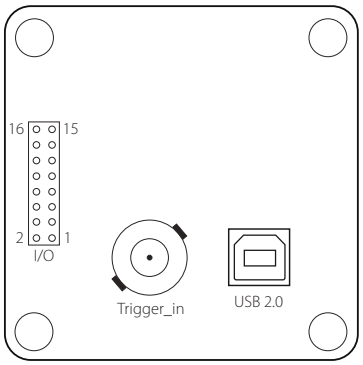
Trigger: The cameras offer a trigger input to determine the moment of exposure. The exposure begins 4.8 µs after the occurrence of a trigger pulse. The length of the exposure in the range of 100 µs to 30 s can be set via software. The duration of the image readout is the reciprocal of the current frame rate. Once the image readout has finished, the camera is able to accept a new trigger pulse at any time.



Digital I/Os - USB Cameras

Pin header

As already mentioned in the introduction, there are two ways to access the camera's digital I/Os: using an internal pin header or an external Hirose connector. To access the internal pin header please open the cameras backplane. You will find connectors as shown in the drawings on the right hand side. Please assemble a cable that fits your application. The pin header consists of 2x8 pins with a pitch of 2.00 x 2.00 mm. Please find its pinout in the table below.



I/O PCB of The Imaging Source USB CCD cameras

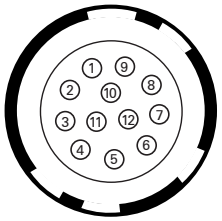
Connector		Signal	I/O	Remarks	Characteristics			
					Min	Typ	Max	Unit
BNC		Trigger_in	I	Start of exposure (optocoupler)	3.3		12.0	V
I/O pin header	Pin 1	Trigger_in (+)	I	ditto (signal)	3.3		12.0	V
	Pin 2	Trigger_in (-)	I	ditto (ground)	-	-	-	-
	Pin 3	do not use	-	For future release	-	-	-	-
	Pin 4	do not use	-	For future release	-	-	-	
	Pin 5	do not use	-	for future release	-	-	-	-
	Pin 6	Strobe_out	O	Flash control (open drain)			24.0[1]	V
	Pin 7	GP_out	O	General purpose output (open drain)			24.0[1]	V
	Pin 8	GP_in	I	General purpose input, V_{IH} = High Level Input Voltage V_{IL} = Low Level Input Voltage	0.6		24.0	V_{IH}
					-0.3	0	0.2	V_{IL}
	Pin 9	GND	G	External ground	-	-	-	-
	Pin 10	GND	G	External ground	-	-	-	-
	Pin 11	do not use	-	For future release	-	-	-	-
	Pin 12	do not use	-	For future release	-	-	-	-
	Pin 13	do not use	-	For future release	-	-	-	-
	Pin 14	do not use	-	For future release	-	-	-	-
	Pin 15	GND	G	External ground	-	-	-	-
	Pin 16	GND	G	External ground	-	-	-	-

Please note:
All specifications are subject to change without notice
[1] max. 0.2 A (ID) for open drain MOSFET

I/O pin legend:
G External Ground
I Input
O Output
P Power supply

Hirose Connector - USB Cameras

As already mentioned in the introduction, there are two ways to access the cameras digital I/Os: using an internal pin header or an external Hirose connector. Please find its pinout in the table below and the position of these pins in the drawing on the right hand side. The part number of this Hirose connector is HR10A-10R-12P(73). To realize a trigger cable you need a Hirose connector HR10A-10P-12S(73).



Connector	Signal	I/O	Remarks	Characteristics			
				Min	Typ	Max	Unit
Pin 1	do not use	-	Reserved, please do not use	-	-	-	-
Pin 2	GND	G	External ground	-	-	-	-
Pin 3	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 4	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 5	SPI_CS	-	Reserved, please do not use	-	-	-	-
Pin 6	SPI_CLK	-	Reserved, please do not use	-	-	-	-
Pin 7	GND	G	External ground	-	-	-	-
Pin 8	GP_in	I	General purpose input, V_{IH} = High Level Input Voltage V_{IL} = Low Level Input Voltage	0.6	-	24.0	V_{IH}
				-0.3	0	0.2	V_{IL}
Pin 9	GP_out	O	General purpose output (open drain)	-	-	24.0[1]	V
Pin 10	Stobe_out	O	Flash control (Open drain)	-	-	24.0[1]	V
Pin 11	Trigger_in (+)	I	Start of exposure (optocoupler signal)	3.3	-	12.0	V
Pin 12	Trigger_in (-)	I	ditto (optocoupler ground)	-	-	-	-

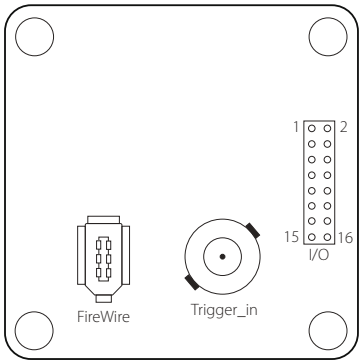
Please note:
All specifications are subject to change without notice
[1] max. 0.2 A (ID) for open drain MOSFET.

I/O pin legend:
G External Ground
I Input
O Output
P Power supply

Digital I/Os - FireWire Cameras

Pin header

As already mentioned in the introduction, there are two ways to access the camera's digital I/Os: using an internal pin header or an external Hirose connector. To access the internal pin header please open the cameras backplane. You will find connectors as shown in the drawings on the right hand side. Please assemble a cable that fits your application. The pin header consists of 2x8 pins with a pitch of 2.00 x 2.00 mm. Please find its pinout in the table below.



I/O PCB of The Imaging Source USB CCD cameras

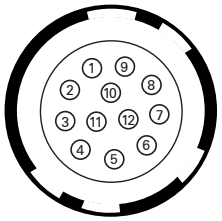
Connector		Signal	I/O	Remarks	Characteristics			
					Min	Typ	Max	Unit
BNC		Trigger_in	I	Start of exposure (optocoupler)	3.3		12.0	V
I/O pin header	Pin 1	Trigger_in (+)	I	ditto (signal)	3.3		12.0	V
	Pin 2	Trigger_in (-)	I	ditto (ground)	-	-	-	-
	Pin 3	FW_PWR	P	**Caution:** directly connected to the power supply of the FireWire bus (pin 2 of the FireWire connector.)	8.0	12.0**	30.0	V
	Pin 4	FW_PWR						
	Pin 5	do not use	-	for future release	-	-	-	-
	Pin 6	Strobe_out	O	Flash control (open drain)			24.0[1]	V
	Pin 7	GP_out	O	General purpose output (open drain)			24.0[1]	V
	Pin 8	GP_in	I	General purpose input, V_{IH} = High Level Input Voltage	0.6		24.0	V_{IH}
				V_{IL} = Low Level Input Voltage	-0.3	0	0.2	V_{IL}
	Pin 9	GND	G	External ground	-	-	-	-
	Pin 10	GND	G	External ground	-	-	-	-
	Pin 11	do not use	-	For future release	-	-	-	-
	Pin 12	do not use	-	For future release	-	-	-	-
	Pin 13	do not use	-	For future release	-	-	-	-
	Pin 14	do not use	-	For future release	-	-	-	-
	Pin 15	GND	G	External ground	-	-	-	-
	Pin 16	GND	G	External ground	-	-	-	-

Please note:
All specifications are subject to change without notice
[1] max. 0.2 A (ID) for open drain MOSFET
** Determined by the power supply of the FireWire bus. This value may vary considerably.

I/O pin legend:
G External Ground
I Input
O Output
P Power supply

Hirose Connector- FireWire Cameras

As already mentioned in the introduction, there are two ways to access the cameras digital I/Os: using an internal pin header or an external Hirose connector. Please find its pinout in the table below and the position of these pins in the drawing on the right hand side. The part number of this Hirose connector is HR10A-10R-12P(73). To realize a trigger cable you need a Hirose connector HR10A-10P-12S(73).



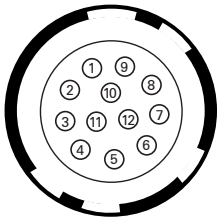
Connector	Signal	I/O	Remarks	Characteristics			
				Min	Typ	Max	Unit
Pin 1	FW-PWR	P	**Caution:** directly connected to the power supply of the FireWire bus (pin 2 of the FireWire connector.)	8.0	12.0**	30.0	V
Pin 2	GND	G	External ground	-	-	-	-
Pin 3	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 4	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 5	SPI_CS	-	Reserved, please do not use	-	-	-	-
Pin 6	SPI_CLK	-	Reserved, please do not use	-	-	-	-
Pin 7	GND	G	External ground	-	-	-	-
Pin 8	GP_in	I	General purpose input, V_{IH} = High Level Input Voltage V_{IL} = Low Level Input Voltage	0.6	-	24.0	V_{IH}
				-0.3	0	0.2	V_{IL}
Pin 9	GP_out	O	General purpose output (open drain)	-	-	24.0[1]	V
Pin 10	Stobe_out	O	Flash control (Open drain)	-	-	24.0[1]	V
Pin 11	Trigger_in (+)	I	Start of exposure (optocoupler signal)	3.3	-	12.0	V
Pin 12	Trigger_in (-)	I	ditto (optocoupler ground)	-	-	-	-

Please note:
All specifications are subject to change without notice
[1] max. 0.2 A (ID) for open drain MOSFET
** Determined by the power supply of the FireWire bus. This value may vary considerably.

I/O pin legend:
G External Ground
I Input
O Output
P Power supply

Digital I/Os - GigE Cameras

As already mentioned in the introduction, there are two ways to access the cameras digital I/Os: using an internal pin header or an external Hirose connector. Please find its pinout in the table below and the position of these pins in the drawing on the right hand side. The part number of this Hirose connector is HR10A-10R-12P(73). To realize a trigger cable you need a Hirose connector HR10A-10P-12S(73).



Connector	Signal	I/O	Remarks	Characteristics			
				Min	Typ	Max	Unit
Pin 1	GigE Power Supply	P	**Caution:** directly connected to the power supply of the GigE camera	12.0	12.0**	24.0	V
Pin 2	GND	G	External ground	-	-	-	-
Pin 3	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 4	SPI_MISO	-	Reserved, please do not use	-	-	-	-
Pin 5	SPI_CS	-	Reserved, please do not use	-	-	-	-
Pin 6	SPI_CLK	-	Reserved, please do not use	-	-	-	-
Pin 7	GND	G	External ground	-	-	-	-
Pin 8	GP_in	I	General purpose input, V_{IH} = High Level Input Voltage V_{IL} = Low Level Input Voltage	0.6	-	24.0	V_{IH}
				-0.3	0	0.2	V_{IL}
Pin 9	GP_out	O	General purpose output (open drain)	-	-	24.0[1]	V
Pin 10	Stobe_out	O	Flash control (Open drain)	-	-	24.0[1]	V
Pin 11	Trigger_in (+)	I	Start of exposure (optocoupler signal)	3.3	-	12.0	V
Pin 12	Trigger_in (-)	I	ditto (optocoupler ground)	-	-	-	-

Please note:
All specifications are subject to change without notice
[1] max. 0.2 A (ID) for open drain MOSFET
** Determined by the power supply of the cameras power suppy. This value may vary considerably.

I/O pin legend:
G External Ground
I Input
O Output
P Power supply

Programming examples with IC Imaging Control®

All The Imaging Source cameras are shipped with the **SDK IC Imaging Control®**. IC Imaging Control® removes a lot of programming effort, since it offers many ready-to-use basic procedures.

Below are brief examples in Visual Basic to give you an idea of how to use IC Imaging Control® to control the trigger and the digital I/Os. You can learn more about IC Imaging Control® and download sample source code at www.imagingcontrol.com. Additionally, our support department (support@imagingcontrol.com) has some more detailed programming examples available for you.

Using the trigger

The program begins by assigning the video `Device` (in this case the FireWire camera DMK 21BF04), defines a `VideoFormat` and sets the camera's operation mode to `DeviceTrigger`.
After the command `LiveStart`, the camera is ready to shoot: the camera now waits for a trigger pulse. `MemorySnapImage` instructs IC Imaging Control® to put the next image (which has been captured due to the trigger pulse) into a buffer (Memory) for further processing. Take as an example `MemorySaveImage`, which saves the content of this buffer to `Triggered.bmp`.

```
Private Sub Form_Load()
    ICImagingControl1.Device = "DMK 21BF04"
    ICImagingControl1.VideoFormat = "Y800 (640x480)"
    ICImagingControl1.DeviceTrigger = True

    ICImagingControl1.LiveStart
    ICImagingControl1.MemorySnapImage

    ' Do something with the image - for instance:
    ICImagingControl1.MemorySaveImage "Triggered.bmp"
End Sub
```

Activating the strobe output

FireWire cameras typically have a set of properties such as "exposure time" or "gain". IC Imaging Control® makes these properties available in the class `VCDSimpleProperty`. The program begins by defining the variable `VCDProp` that will later contain these properties.

Secondly, the video Device is assigned (in this case the FireWire camera DMK 21BF04) and then we define a `VideoFormat`. The function `GetSimplePropertyContainer` assigns the properties of the opened camera to the variable `VCDProp`.

The command `VCDProp.Switch(VCDID_Strobe) = True` activates the strobe output. Therefore, after having started the camera with `LiveStart`, pin 6 indicates the CCDs exposure.

```
Private Sub Form_Load()
    Dim VCDProp As VCDSimpleProperty
    ICImagingControl1.Device = "DMK 21BF04"
    ICImagingControl1.VideoFormat = "Y800 (640x480)"
    VCDProp = GetSimplePropertyContainer(ICImagingControl1.VCDPropertyItems)

    VCDProp.Switch(VCDID_Strobe) = True
    ICImagingControl1.LiveStart
End Sub
```

Reading the digital input

The first three program lines are similar to those of the preceding example (Activating the strobe output). The main difference is to be found at the programs end: The command `VCDProp.OnePush VCDElement_GPIORead` reads the digital inputs state, while `Debug.Print VCDProp.RangeValue(VCDElement_GPIOIn)` indicates this state in terms of a debug output.

```
Private Sub Form_Load()
    Dim VCDProp As VCDSimpleProperty
    ICImagingControl1.Device = "DMK 21BF04"
    VCDProp = GetSimplePropertyContainer(ICImagingControl1.VCDPropertyItems)

    VCDProp.OnePush VCDElement_GPIORead
    Debug.Print VCDProp.RangeValue(VCDElement_GPIOIn)
End Sub
```

Setting the digital output

The first three program lines are similar to those of the preceding example (Reading the digital input). The main difference is to be found at the end of the programs: The command VCDProp.`RangeValue` sets the variable `VCDElement_GPIOOut` to 0, whereupon `VCDProp.OnePush VCDElement_GPIOWrite` copies the content of this variable (0 in our case) to the digital output.

```
Private Sub Form_Load()
    Dim VCDProp As VCDSimpleProperty
    ICImagingControl1.Device = "DMK 21BF04"
    VCDProp = GetSimplePropertyContainer(ICImagingControl1.VCDPropertyItems)

    VCDProp.RangeValue(VCDElement_GPIOOut) = 0
    VCDProp.OnePush VCDElement_GPIOWrite
End Sub
```

THE IMAGINGSOURCE
TECHNOLOGY BASED ON STANDARDS

Headquarters: The Imaging Source Europe GmbH
Sommerstrasse 36, D-28215 Bremen, Germany
Phone: +49 421 33591-0
North & South America: The Imaging Source, LLC
6926 Shannon Willow Rd, S 400, Charlotte, NC 28226, USA
Phone: +1 704-370-0110
Asia Pacific: The Imaging Source Asia Co. Ltd.
6F-1, No.230, Sec.3, Ba-De Road,,Song-Shan District 10555,
Taipei City, Taiwan
Phone: +886 2-2577-1228
www.theimagingsource.com

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All weights and dimensions are approximate. Unless otherwise specified the lenses shown in the context of cameras are not shipped with these cameras.