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GenICam ICD FLIR IR Camera - PC

Contents

1 Connectivity Overview

1.1 Physical interfaces

The FLIR IR camera, when used for GenICam data transfer, can be used in two ways.

- Dedicated Gigabit Ethernet
- Shared Ethernet

A Dedicated Gigabit Ethernet is recommended for high speed applications and when image streaming would disturb other equipment on a Shared Ethernet.

1.2 Low level protocols

On the mentioned physical interface, it is possible to run different low level protocols.

1.2.1 Ethernet

The IP GigEVision streaming protocol is used for image transfer and the GigEVision control protocol is used for camera control.

Some other IP protocols are supported for network management functions. They should work seamlessly on any LAN, provided that a proper IP adress, netmask and possibly gateway is set in the camera.

1.3 Functionality

The ethernet communication functionality is provided by an iPORT IP Engine inside the camera. You can use it to manage image streaming and control the camera through the GenICam command control interface.

1.3.1 GenICam

To be able to acquire images and control the camera, you have to have a software environment that meets the specifications of the machine vision standards GigE Vision and GenICam. For more information about this, see http://www.genicam.org/.

Such environments are, for example,

- "Measurement and Automation Explorer (MAX)" from National Instruments.
- "EBus Pure GEV SDK" from Pleora Technologies.
- "EBus Vision SDK" from Pleora Technologies.
- "Common Vision Blox" from Stemmer Imaging.

The camera supports the GenICam standard command set, and some FLIR specific commands.

The GenICam Standard Features Naming Convention (available at http://www.genicam.org/) is used.

1.3.2 IP services

1.3.2.1 DHCP

The camera supports the client part of the Dynamic Host Configuration Protocol (DHCP).

1.3.2.2 Remote detection

1.3.2.2.1 Multicast DNS (Bonjour)

To query Bonjour for local FLIR IR cameras, use

- Service name: flir-ircam
- Protocol type: _tcp
- Domain: local

Name	Value (example)	Explanation
model	R	
ID	A320G	Camera ID
GID	Gen_A/G	Generic ID
SI	GEV	Streaming Interface
SIV	1.0.0	Streaming interface version *)
CI	GEV	Command interface
CIV	1.0.0	Command interface version *)

Table 1: TXT records

*) The version information provided here is (unfortunately) not accurate. You need to check The DeviceManufacturerInfo register.

For more information, see http://www.dns-sd.org

1.3.2.2.2 GigEVision Control Protocol (GVCP)

GigEVision camera queries return the model name and MAC address of the cameras found.

For more information, see http://www.machinevisiononline.org

2 GeniCam Commands

2.1 Introduction

The goal of GenICam is to provide a generic programming interface for all kinds of cameras.

The GenICam standard consists of multiple modules according to the main tasks to be solved:

- GenApi : GenICam application programming interface (API) for camera configuration and control
- GenTL : GenICam transport layer (TL) for grabbing images

The GenApi module deals with the problem of how to configure and control a camera. The key idea is to make camera manufacturers provide machine readable versions of the manuals for their cameras. These camera description files contain all of the required information to automatically map a camera's features to named *registers*.

The GenTL module is still under construction. Until it is finished, image transfers are made through software environment specific interfaces.

This section defines the GenICam registers of the GigEVision compatible camera.

Inside the FLIR IR camera, there is an iPORT IP Engine. It has a number of status registers and registers that control the way in which it acquires images from the camera.

From the iPORT IP Engine point of view, the FLIR IR camera is regarded as a GigE Vision device with some special FLIR Camera features.

To be able to use these registers to acquire images and control the camera, you have to establish a connection to it through a software environment that meets the specifications of the machine vision standards GigE Vision and GenICam, such as the eBus SDK from Pleora Technologies.

2.2 GenICam registers

Depending on the camera model, all registers may not be available or functional on a particular camera.

2.2.1 Register types

The registers have one of the following types:

Integer	An integer value, between -2 147 483 648 and 2 147 483 647.
String (max length including null)	An ASCII string, for example "ThermaCAM". The string must be terminated with a Null (binary 0) character
Bool	The integer value 1 for true, or the integer value 0 for false.
Float	An IEEE 754 -1985 encoded floating point value, between ±3.4028235×10^38 .
Enum	An integer value with a specific encoding.
Cmd	An integer value with a specific encoding used as a command.

They can be accessed in one of these three ways:

RO	Read only
RW	Read write
WO	Write only

2.2.2 IP Engine status and control

To establish a connection through the Pleora Indigo SDK, you have to connect using the IP-number of the camera and retrieve a handle to the map of register nodes. Information about them will automatically be downloaded from the camera.

2.2.2.1 Device Information registers

Registers associated with device information

Name	Type	Access	Comment
DeviceVendorName	String (32)	RO	Provides the name of the manufacturer of the device.
DeviceModelName	String (32)	RO	Provides the model of the device.
DeviceVersion	String (32)	RO	Provides the version of the device.
DeviceManufacturerInfo	String (48)	RO	Provides extended manufacturer information about the device. *)
DeviceID	String (16)	RO	This register holds a camera identifier.
DeviceUserID	String (16)	RW	This register holds a user-programmable identifier

*) The DeviceManufacturerInfo register contains six entries separated by commas (Camera ID, Generic ID, Streaming interface, Streaming interface version, Command interface, Command interface version), for example: "A320G, Gen_A/G, GEV, 1.0.0,GEV,0.2.1".

2.2.2.2 IP Engine status registers

Registers associated with the IP Engine status

Name	Type	Access	Comment
IPEngineFirmwareVersionMajor	Integer	RO	This register represents the major version of the iPORT IP Engine firmware.
IPEngineFirmwareVersionMinor	Integer	RO	This register represents the minor version of the iPORT IP Engine firmware.
IPEngineInitSequenceStatus	Integer	RO	This register reports the status of the initialization sequence. A null value indicates that the initialization sequence ran successfully. Otherwise, it returns the index of the register write that failed in the sequence.

2.2.3 GigE Vision (GEV) standard interface

2.2.3.1 GigE Vision Image size control registers

Registers associated with the image size.

Name	Type	Access	Comment
Width	Integer	RW	This register represents the current image width from the camera (in pixels). Mandatory GEV feature.
Height	Integer	RW	This register represents the current image height from the camera (in pixels). Mandatory GEV feature.
OffsetX	Integer	RW	This register represents the horizontal distance (in pixels) from the center of the detector to the center of the image. This offset plus the current image width cannot exceed the detector width.
OffsetY	Integer	RW	This register represents the vertical distance (in pixels) from the center of the detector to the center of the image. This offset plus the current image width cannot exceed the detector height.
PixelFormat	Enum	RW	This register indicates the format of the pixel to use during the acquisition. Pixel format as defined in GVSP (the GigEVision Streaming Protocol). Mandatory GEV feature.
PayloadSize	Integer	RO	Number of bytes transferred for each image on the stream channel. Mandatory GEV feature.
TestImageSelector	Enum	RW	This feature selects the type of test image that is created by the GEV interface board. 0=Off 1= TestPattern

2.2.3.2 GigE Vision Acquisition control registers

Registers associated with the IP Engine acquisition of images from the camera and their transmission on the ethernet.

Name	Type	Access	Comment
AcquisitionFrameCount	Integer	RW	This register provides the number of frames to be acquired in MultiFrame Acquisition mode.
AcquisitionMode	Enum	RW	This register controls the acquisition mode of the device. Mandatory GEV feature. 0=Continuous 1=SingleFrame 2=MultiFrame
AcquisitionStart	Cmd	WO	This register starts the Acquisition of the device. Mandatory GEV feature.
AcquisitionStop	Cmd	WO	This register stops the Acquisition of the device at the end of the current Frame. Mandatory GEV feature.

2.2.3.3 GigE Vision Network Configuration registers

Registers associated with the GEV transport protocol.

Name	Type	Access	Comment
GevVersionMajor	Integer	RO	This register represents the major version of the GEV specification
GevVersionMinor	Integer	RO	This register represents the minor version of the specification.
GevDeviceModeIsBigEndian	Bool	RO	Endianness might be used to interpret multi-byte data for READMEM and WRITEMEM commands.
GevDeviceModeCharacterSet	Enum	RO	This register represents the character set used by all the strings of the bootstrap registers.
GevMACAddressHigh	Integer	RO	This register stores the upper two bytes of the MAC address of the given network interface.
GevMACAddressLow	Integer	RO	This register stores the lower four bytes of the MAC address of the given network interface.
GevSupportedIPConfigurationLLA	Bool	RO	This register indicates if Link Local Address IP configuration scheme is supported by the given network interface.
GevSupportedIPConfigurationDHCP	Bool	RO	This register indicates if DHCP IP configuration scheme is supported by the given network interface
GevSupportedIPConfigurationPersistentIP	Bool	RO	This register indicates if Persistent IP configuration scheme is supported by the given network interface.
GevCurrentIPConfigurationLLA	Bool	RW	This register indicates if Link Local Address IP configuration scheme is activated on the given network interface.
GevCurrentIPConfigurationDHCP	Bool	RW	This register indicates if DHCP IP configuration scheme is activated on the given network interface.
GevCurrentIPConfigurationPersistentIP	Bool	RW	This register indicates if PersistentIP configuration scheme is activated on the given network interface
GevCurrentIPAddress	Integer	RO	This register reports the IP address for the given network interface once it has been configured.

Name	Type	Access	Comment
GevCurrentSubnetMask	Integer	RO	This register provides the subnet mask of the given interface.
GevCurrentDefaultGateway	Integer	RO	This register indicates the default gateway IP address to be used on the given network interface.
GevFirstURL	String (512)	RO	This register holds the first URL to the XML device description file.
GevSecondURL	String (512)	RO	This register holds the second URL to the XML device description file.
GevNumberOfInterfaces	Integer	RO	This register indicates the number of physical network interfaces supported by this device
GevPersistentIPAddress	Integer	RW	This register indicates the Persistent IP address for this network interface.
GevPersistentSubnetMask	Integer	RW	This register indicates the Persistent subnet mask associated with the Persistent IP address on this network interface.
GevPersistentDefaultGateway	Integer	RW	This register indicates the persistent default gateway for this network interface.
GevHeartbeatTimeout	Integer	RW	This register indicates the current heartbeat timeout in milliseconds.
GevCCP	Enum	RW	This register is used to grant privilege to an application. 0=Open access 1=Exclusive access 2=Control access
GevSCPInterfaceIndex	Integer	RW	Index of network interface to use (from 0 to 3).

To make the iPort announce network configuration changes on the ethernet, you have to reset the iPort using the FLIR command register PT1000Reset.

2.2.4 FLIR Camera interface

2.2.4.1 Feature registers

Registers associated with camera features

Name	Type	Access	Comment
CameraCapabilities	Integer	RO	Camera capabilities. Bit mask. 0=Focus, auto focus single shot 1=Focus, motor 2=Digital I/O capable 3=IRWindowing
PowerMode	Enum	RO	0=A/C powered 1=Power over Ethernet
PT1000Reset	Cmd	WO	Reset the iPORT interface board.

2.2.4.2 Range (case) registers

The camera has a list of measurement ranges (called calibration cases) which you can inspect through these registers. You can also make the camera switch to one of them using the CurrentCase register.

There is one set of cases for each lens the camera has been calibrated with. The first lens would normally occupy cases 0, 1 and 2. The second lens cases 3, 4 and 5.

Some cases can be disabled. If the camera doesn't have a high temperature option, cases 2, 5, 8 etc will normally be disabled.

To retrieve data for a particular case, set its number in QueryCase register and read the range data in the QueryCaseXXXX registers.

Switching cases is quite a slow procedure. It can take up to 10 seconds. If it fails, the CurrentCase will eventually return to the previous value.

Name	Type	Access	Comment
NumCases	Integer	RO	Number of available cases
CurrentCase	Integer	RW	Current zero based case.
QueryCase	Integer	RW	Query case zero based index. This register controls the content of QueryCaseLowLimit, QueryCaseHighLimit and QueryCaseEnabled.
QueryCaseLowLimit	Float	RO	Queried case low limit in Kelvin.
QueryCaseHighLimit	Float	RO	Queried case high limit in Kelvin.
QueryCaseEnabled	Bool	RO	True if the queried case is enabled.

2.2.4.3 Object Parameter registers

Registers associated with infrared measurement conditions.

Name	Type	Access	Comment
ReflectedTemperature	Float	RW	Kelvin, 0.0 - 5000.0
AtmosphericTemperature	Float	RW	Kelvin, 0.0 - 5000.0
ObjectDistance	Float	RW	Meter, 0.0 - 10000.0
ObjectEmissivity	Float	RW	0.0 - 1.0
RelativeHumidity	Float	RW	Percent, 0.0 - 100.0
ExtOpticsTemperature	Float	RW	Kelvin, 0.0 - 5000.0
ExtOpticsTransmission	Float	RW	0.0 - 1.0
EstimatedTransmission	Float	RW	0.01 - 1.0 0.0 = Use calculated value.

2.2.4.4 Focus registers

Registers associated with camera focus operation

Name	Type	Access	Comment
FocusSpeed	Integer	RW	0 to 100 (0 = permanent stop)
FocusDirection	Enum	RW	Stop = 0 Far = 1 Near = 2
AutoFocusMethod	Enum	RW	0=Coarse 1=Fine
AutoFocus	Cmd	WO	Perform auto focus operation.
FocusPos	Integer	RW	Absolute focus position A high value means a far distance on some types of cameras, a near distance on others.
FocusDistance	Float	RW	Focus position as distance in meters *) Min = 0 Max = 1000
FocusStep	Integer	RW	Absolute focus position change amount for FocusDecrement and FocusIncrement. *) Small values (<250) might not move the focus. Min = 0 Max = 1000
FocusDecrement	Cmd	WO	Decrements the focus position by the value in FocusStep *)
FocusIncrement	Cmd	WO	Increments the focus position by the value in FocusStep *)

*) Needs command interface version 0.2.12. See the DeviceManufacturerInfo register

2.2.4.5 Image quality registers

Registers associated with the image quality

Name	Type	Access	Comment
NoiseReduction	Enum	RW	0 = Off 1 = Low etc.
NUCMode	Enum	RW	Non-Uniform Correction (NUC) mode Off = 0 Automatic by camera=1
NUCAction	Cmd	WO	Do NUC operation. This can take up to 10 seconds.

2.2.4.6 Image stream registers

Registers associated with the image format or with the image stream..

Name	Type	Access	Comment
IRFormat	Enum	RW	0=Signal linear 1=Temperature linear, 0.1K resolution 2=Temperature linear, 0.01K resolution
IRTestPattern	Enum	RW	This register selects the type of test image that is created by the IR camera. 0=Off (see IRFormat) 1= TestPattern
IRFrameRate	Enum	RW	Camera model dependent values, normal non-windowing examples: 0= 60Hz/50Hz 1= 30Hz/25Hz 2= 15Hz/12.5Hz ... The availability of some frame rates can depend on the image width, height and offset settings. When IRWindowing is used, the frame rate increases by the same amount as the image height decreases.
IRWindowing	Enum	RW	This register can only be changed when no streaming is going on. It moves the vertical start of the image and changes the frame rate. You must change the "Height" register accordingly. 0=Off (Full height, normal rate) 1=Half (Half height, double rate) 2=Quarter (Quarter height, fourfold rate)

The image pixels are transferred left to right, row by row, from top to bottom. The byte order is in accordance with the GevDeviceModeIsBigEndian register.

2.2.4.7 External I/O registers

Registers associated with configuring camera external I/O ports.

Name	Type	Access	Comment
NumPorts	Integer	RO	Number of available I/O ports.
CurrentPort	Integer	RW	Current selected I/O port. Zero based index.
CurrentIOType	Enum	RO	Type of I/O port 0=Digital 1=Analog
CurrentIODirection	Enum	RO	0=Input 1=Output 2=Bi-directional
CurrentIOConfig	Integer	RW	Port function configuration. 0=General Purpose 1=Vertical sync (output only) 2=Set Mark in IR image (input only) 3=Set Start mark in IR image (input only) 4=Set Stop mark in IR image (input only) 5=Enable image flow (input only) 6=Disable image flow (input only)
CurrentIOPolarity	Enum	RW	Output port polarity 0=Active High 1=Active Low
CurrentIOSensitivity	Enum	RW	Input port edge sensitivity (IOConfig 2,3,4, 5 and 6 only) 0=Rising edge 1=Falling edge 2=Both rising and falling edge
CurrentIOState	Enum	RW	Current I/O port state 0=Deasserted 1=Asserted

The CurrentIOConfig Vertical sync output configuration provides a short pulse (about 150 µs) whenever a new image starts.