

FLIR Systems

EtherNet/IP and Modbus TCP Object Models

Object Model revision: 1.22

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Chapter 1 Introduction to EtherNet/IP

Ethernet/IP™ (EIP) is a high-level industrial application layer protocol for industrial automation applications. Built on the standard TCP/IP protocol suite, EIP uses all the traditional Ethernet hardware and software to define an application layer protocol that structures the task of configuring, accessing and controlling industrial automation devices. Ethernet/IP classifies Ethernet nodes as predefined device types with specific behaviors. The set of device types and the EIP application layer protocol is based on the Control and Information Protocol (CIP) layer used in both DeviceNet™ and ControlNet™. Building on these widely used protocol suites, Ethernet/IP for the first time provides a seamless integrated system from the sensor-actuator network to the controller and enterprise networks. EIP provides a wide-ranging, comprehensive, certifiable standard suitable to a wide variety of automation devices.

Ethernet/IP uses the tools and technologies of traditional Ethernet

Ethernet/IP uses all the transport and control protocols used in traditional Ethernet, including the Transport Control Protocol (TCP), the Internet Protocol (IP), and the media access and signaling technologies found in off-the-shelf Ethernet interface cards. Building on these standard PC technologies means that EIP works transparently with all the standard off-the-shelf Ethernet devices found in today's marketplace. It also means that EIP can be easily supported on standard PCs and all their derivatives. Even more importantly, basing EIP on a standard technology platform ensures that EIP will move forward as the base technologies evolve.

Ethernet/IP is a certifiable standard

EtherNet/IP ensures a comprehensive, consistent standard by careful, multi-vendor attention to the specification and through certified test labs as is used for other well-known communication standards like DeviceNet and ControlNet. The EtherNet/IP Certification program ensures the consistency and quality of field devices.

EIP is built on a widely accepted protocol layer

EIP is constructed from a very widely implemented standard used in DeviceNet and ControlNet called the Control and Information Protocol (CIP). This standard organizes networked devices as a collection of objects. It defines the access, object behavior and extensions which allow widely disparate devices to be accessed using a common mechanism. Over 500 vendors now support the CIP protocol in present day products. Using this technology in EIP means that EIP is based on a widely understood, widely implemented standard that does not require a new technology shakedown period.

CIP – The Core of EtherNet/IP

The Communications and Information Protocol (CIP) is a communications protocol for transferring automation data between two devices. In the CIP Protocol, every network device represents itself as a series of objects. Each object is simply a grouping of the related data values in a device. For example, every CIP device is required to make an Identity object available to the network. The identity object contains related identity data values called attributes. Attributes for the identity object include the vendor ID, date of manufacture, device serial number, and other identity data. CIP does not specify at all how this object data is implemented, only what data values or attributes must be supported and that these attributes must be available to other CIP devices.

The Identity object is an example of a required object. There are three types of objects defined by the CIP protocol; Required Object, Application Objects and Vendor Specific Objects. The collection of specific object for a particular device is known as the device's **Object Model**.

REQUIRED OBJECTS

Required objects are required by the specification to be included in every CIP device. These objects include the Identity object, a Message Router object and a Network object.

The identity object contains related identity data values called attributes. Attributes for the identity object include the vendor ID, date of manufacturer, device serial number, and other identity data.

The Message Router object is an object which routes explicit request messages from object to object in a device.

A Network object contains the physical connection data for the object. For a CIP device on DeviceNet, the network object contains the MacID and other data describing the interface to the CAN network. For EIP devices, the network object contains the IP address and other data describing the interface to the Ethernet port on the device.

APPLICATION OBJECTS

Application objects are the objects that define the data encapsulated by the device. These objects are specific to the device type and function. For example, a Motor object on a Drive System has attributes describing the frequency, current rating and motor size. An Analog Input object on an I/O device has attributes that define the type, resolution and current value for the analog input.

These application layer objects are predefined for a large number of common device types. All CIP devices with the same device type (Drive Systems, Motion Control, Valve Transducer...etc) must contain the identical series of application objects. The series of application objects for a particular device type is known as the device profile. A large number of profiles for many device types have been defined. Supporting a device profile allows a user to easily understand and switch from a vendor of one device type to another vendor with that same device type.

A device vendor can also group Application Layer Objects into assembly objects. These super objects contain attributes of one or more Application Layer Objects. Assembly objects form a convenient package for transporting data between devices. For example, a vendor of a

Temperature Controller with multiple temperature loops may define assemblies for each of the temperature loops and an assembly with data from all temperature loops. The user can then pick the assembly that is most suited for the application and how often to access each assembly. For example, one temperature assembly may be configured to report every time it changes state while the second may be configured to report every one-second regardless of a change in state.

Assemblies are usually predefined by the vendor, but CIP also defines a mechanism in which the user can dynamically create an assembly from application layer object attributes.

VENDOR SPECIFIC OBJECTS

Objects not found in the profile for a device class are termed Vendor Specific. The vendor includes these objects as additional features of the device. The CIP protocol provides access to these vendor extension objects in exactly the same method as either application or required objects. This data is strictly of the vendor's choosing and is organized in whatever method makes sense to the device vendor.

In addition to specifying how device data is represented to the network, the CIP protocol specifies a number of different ways in which that data can be accessed such as cyclic, polled and change-of-state.

ADVANTAGES TO EIP

The advantages of the CIP protocol layer over EtherNet/IP are numerous. The consistent device access means that a single configuration tool can configure CIP devices on different networks from a single access point without using vendor specific software. The classification of all devices as objects decreases the training and startup required when new devices are brought online. EIP provides improved response time and greater data throughput than DeviceNet and ControlNet. EIP links devices from the sensor bus level to the control level to the enterprise level with a consistent application layer interface.

PLC COMMUNICATION OVER ETHERNET/IP

Two types of devices communicate over EtherNet/IP. One type, Adapters, are the devices that move I/O between the physical world and the EtherNet/IP network. Adapter devices are "end" devices in a network. Valves, Drives, I/O Devices and Cameras are typically Adapter devices. The Flir camera is an Adapter device. The other device is a Scanners device. Scanners open connections and send outputs to one or more Adapter devices. A Programmable Controller is a typically a Scanner device in an EtherNet/IP network.

Scanner devices send outputs to one or more Adapter devices. Adapter devices send inputs to a Scanner. The Output Assembly Instances defined later in this document defines the outputs sent from the Scanner device to the FLIR Camera. The Input Assembly Instance defined later in this document defines the inputs sent from the Camera to the Scanner device.

EtherNet/IP Electronic Data Sheets Files

Electronic Data Sheets (EDS) are simply ASCII files that describe how a device can be used on an EtherNet/IP network. It describes the objects, attributes and services available in the device.

At the minimum, an EDS file conveys the identity information required for a network tool to recognize the device. For EtherNet/IP Scanners, the EDS File conveys information on the EtherNet/IP Adapters I/O messages. It details the specifics of the Input Message produced by the EtherNet/IP Adapter and the Output message consumed by the Adapter.

The amount of information stored in an EDS file varies from device to device. Some manufacturers store the minimum amount of information in the EDS file while other devices store all the details of every object and attribute in the device.

EDS files are sometimes shipped with a device in some media format like a CD or made available on the device manufacturers website. Some devices with extended data storage contain the EDS file internally within the device.

EDS File Structure

- File Section – Administers the EDS file. Sometimes the URL keyword provides a link to a website where the latest version of the EDS can be found.
- Device Section – Provides keying information that matches the EDS to a particular revision of a device. The first three attributes of the Identity Object (Object #1) are used by network tools to verify that this EDS file (Vendor, Model,...etc) plus the device revision matches the information found in the device. The network tool will not connect to a device unless all four Identity Object Parameters match. Some people mistakenly believe that the Minor Revision number is included in this match but that is not true.
- Device Classification Section – Classifies the EDS for an EtherNet/IP network. The Device Classification Section is required for all EtherNet/IP devices.
- Connection Manager Section – Identifies the CIP connections that are available in the device. This section indicates to the EtherNet/IP Scanner the Triggers and Transports available in the device. If a device supports multiple connections then every connection must be detailed in this section. Only connections that are specified in this section can be used in an EDS-based configuration tool.
- Assembly, Params and ParamClass section – These sections are filled in as needed. For values that are limited to a limited to a defined set of values, Enumeration can be used to specify those values. Value ranges can be specified here also for Configurable parameters.
- Capacity Section – This section indicates the number of connections available in the device and the connection speeds
- Port Section – This section describes the Ethernet port. It is only applicable to devices that perform CIP routing. It is unnecessary for devices containing a single CIP port.

EtherNet/IP Add-on Profiles

The RSLogix5000 Programming Tool from Rockwell Automation uses EtherNet/IP EDS files to understand the Object Model of an EtherNet/IP device. The EDS file describes what data is contained in the messages received from the EtherNet/IP device and what data it should send to the EtherNet/IP device. The addition of an EDS file to the standard RSLogix5000 device library is called an Add-on Profile by Rockwell Automation.

EDS files can be loaded into the RSLogix5000 programming tool in one of two ways. EDS files from vendors which are not highly integrated with Rockwell Automation are loaded manually. EDS files from vendors which are highly integrated with Rockwell Automation, like Flir, are automatically loaded and available with the more recent versions of RSLogix5000.

Chapter 2 EtherNet/IP Object Model

Table 2-1 describes data types used in this Object Model.

Table 2-1 Data types

Data Type	Description
USINT	Unsigned Short Integer (8-bit)
UINT	Unsigned Integer (16-bit)
UDINT	Unsigned Double Integer (32-bit)
DINT	Signed Double Integer (32-bit)
INT	Signed Integer (16-bit)
STRING	Character String (1 byte per character)
SHORT STRING _{nn}	Character String (1 st byte is length; up to <i>nn</i> characters)
BYTE	Bit String (8-bits)
WORD	Bit String (16-bits)
DWORD	Bit String (32-bits)
REAL	IEEE 32-bit Single Precision Floating Point

The following sections list each object's required attributes and services, if any.

IMPORTANT NOTES:

- All Double Precision Floating Point Values in the camera will be converted to Single Precision Floating Point Values over EtherNet/IP.
- We are assuming that every call to the camera is a blocking call. Verify that the I/O RPI is large enough so no connections are dropped.
- EtherNet/IP is a Little-Endian protocol, meaning that the data order is least significant byte to most significant byte.

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1.1 Identity Object (01_{HEX} - 1 Instance)

The following tables contain the attribute, status, and common services information for the Identity Object.

Table 2-2 Identity Object (01_{HEX} - 1 Instance)

Instance	Attribute ID	Name	Data Type	Data value	Access rule
Class (Instance 0)	1	Revision	UINT	1	Get
Instance 1	1	Vendor number	UINT	1161	Get
	2	Device type	UINT	43	Get
	3	Product code number	UINT	320 = “FLIR A310” 321 = “FLIR Ax8”	Get
	4	Product major revision Product minor revision	USINT USINT	02 40	Get
	5	Status	WORD	Always 0	Get

Instance	Attribute ID	Name	Data Type	Data value	Access rule
	6	Serial number	UDINT	Unique 32 bit value	Get
	7	Product name	SHORT STRING32	Depends on camera model.	Get

Table 2-3 Identity Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
05 _{Hex}	No	Yes	Reset ¹
0E _{Hex}	Yes	Yes	Get_Attribute_Single

1.2 Message Router Object (02_{HEX} - 0 Instances)

No supported services or attributes

1.3 Assembly Object (04_{HEX} - 8 Instances)

The following tables contain the attribute, instance, data mapping, and common services information for the Assembly Object.

Table 2-4 Assembly Object (04_{HEX} - 2 Instances)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	2	Get
	2	Max instance	UINT	0x81	Get

¹ If the Reset Service Code is sent with just a Class ID of 0x01 and Instance ID of 0x01, then a Normal Reset will occur.

If the Reset Service Code is sent with a Class ID of 0x01, Instance ID of 0x01, and an additional value of 1, then the camera will resume with Factory Default settings.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule						
Output <i>0x70</i>	3	Output Data							Get/Set		
		Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2		Bit 1	Bit 0
		0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full		Force NUC	Auto NUC
		1	Reserved	Reserved	Image Live	Image Freeze	Reserved	Reserved		DO 2	DO 1
		2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic		Camera Label Graphic	Enable Overlay Graphics
		3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic		Lens Graphic	Relative Humidity Graphic
Output <i>0x71</i>	3	Output Data							Get/Set		
		Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2		Bit 1	Bit 0
		0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full		Force NUC	Auto NUC
		1	Reserved	Reserved	Image Live	Image Freeze	Reserved	Reserved		DO 2	DO 1
		2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic		Camera Label Graphic	Enable Overlay Graphics
		3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic		Lens Graphic	Relative Humidity Graphic
		4	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved	Reserved
		5	Set Configuration Preset (RESERVED FOR FUTURE USE)								
		6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved	Reserved
		7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved	Reserved

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Input 0x64	3	Input Data								Get
	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	1	Disable Alarms ¹	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
	2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
	4	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	5	Set Configuration Preset (RESERVED FOR FUTURE USE)								
	6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	8-11	Delta Temperature 1								
	12-15	Delta Temperature 2								
	16-19	Delta Temperature 3								
	20-23	Delta Temperature 4								
	24-27	Delta Temperature 5								
	28-31	Delta Temperature 6								
	32-35	Internal Camera Temperature								
	36-39	Spot 1 Temperature								
	40-43	Box 1 Min Temperature								
	44-47	Box 1 Max Temperature								
	48-51	Box 1 Average Temperature								
	52	Spot 1 Temperature Valid State								
	53	Box 1 Min Temperature Valid State								
	54	Box 1 Max Temperature Valid State								
	55	Box 1 Avg Temperature Valid State								
	56-59	Spot 2 Temperature								
	60-63	Box 2 Min Temperature								
	64-67	Box 2 Max Temperature								
	68-71	Box 2 Average Temperature								
	72	Spot 2 Temperature Valid State								
	73	Box 2 Min Temperature Valid State								
	74	Box 2 Max Temperature Valid State								
	75	Box 2 Avg Temperature Valid State								
76-79	Spot 3 Temperature									
80-83	Box 3 Min Temperature									
84-87	Box 3 Max Temperature									
88-91	Box 3 Average Temperature									

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

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Input <i>0x64</i> <i>(cont)</i>	3	92	Spot 3 Temperature Valid State							Get
		93	Box 3 Min Temperature Valid State							
		94	Box 3 Max Temperature Valid State							
		95	Box 3 Avg Temperature Valid State							
		96-99	Spot 4 Temperature							
		100-103	Box 4 Min Temperature							
		104-107	Box 4 Max Temperature							
		108-111	Box 4 Average Temperature							
		112	Spot 4 Temperature Valid State							
		113	Box 4 Min Temperature Valid State							
		114	Box 4 Max Temperature Valid State							
		115	Box 4 Avg Temperature Valid State							

Input <i>0x65</i>	3	Input Data								Get	
		Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1		Bit 0
		0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC		Auto NUC
		1	Disable Alarm ¹	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2		DO 1
		2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic		Enable Overlay Graphics
		3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic		Relative Humidity Graphic
		4	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2		Alarm 1
		5	Set Configuration Preset (RESERVED FOR FUTURE USE)								
		6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved
		7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved
		8-11	Delta Temperature 1								
		12-15	Delta Temperature 2								
		16-19	Delta Temperature 3								
		20-23	Delta Temperature 4								
		24-27	Delta Temperature 5								
		28-31	Delta Temperature 6								
		32-35	Internal Camera Temperature								
		36-39	Spot 1 Temperature								
		40-43	Box 1 Min Temperature								
		44-47	Box 1 Max Temperature								
		48-51	Box 1 Average Temperature								
		52	Spot 1 Temperature Valid State								
		53	Box 1 Min Temperature Valid State								
		54	Box 1 Max Temperature Valid State								

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

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Input <i>0x65</i> (cont.)	3	55	Box 1 Avg Temperature Valid State	Get
		56-59	Spot 2 Temperature	
		60-63	Box 2 Min Temperature	
		64-67	Box 2 Max Temperature	
		68-71	Box 2 Average Temperature	
		72	Spot 2 Temperature Valid State	
		73	Box 2 Min Temperature Valid State	
		74	Box 2 Max Temperature Valid State	
		75	Box 2 Avg Temperature Valid State	
		76-79	Spot 3 Temperature	
		80-83	Box 3 Min Temperature	
		84-87	Box 3 Max Temperature	
		88-91	Box 3 Average Temperature	
		92	Spot 3 Temperature Valid State	
		93	Box 3 Min Temperature Valid State	
		94	Box 3 Max Temperature Valid State	
		95	Box 3 Avg Temperature Valid State	
		96-99	Spot 4 Temperature	
		100-103	Box 4 Min Temperature	
		104-107	Box 4 Max Temperature	
		108-111	Box 4 Average Temperature	
		112	Spot 4 Temperature Valid State	
		113	Box 4 Min Temperature Valid State	
		114	Box 4 Max Temperature Valid State	
		115	Box 4 Avg Temperature Valid State	
		116-135	.....Spot 5/ Box 5.....
		136-155	.....Spot 6/ Box 6.....
		156-175	.....Spot 7/ Box 7.....
		176-195	.....Spot 8/ Box 8.....
		196-215	.....Spot 9/ Box 9.....
		216-235	.....Spot 10/ Box 10.....
		236-255	.....Spot 11/ Box 11.....
		256-275	.....Spot 12/ Box 12.....
		276-295	.....Spot 13/ Box 13.....
		296-315	.....Spot 14/ Box 14.....
		316-335	.....Spot 15/ Box 15.....
		336-355Spot 16/ Box 16.....	
		356-375Spot 17/ Box 17.....	
		376-395Spot 18/ Box 18.....	
		396-415Spot 19/ Box 19.....	

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Input 0x65 (cont.)	3	416-435Spot 20/ Box 20.....	Get
Input 0x66	3	Input Data		Get
		Byte	Bit 7 Bit 6 Bit 5 Bit 4 Bit 3 Bit 2 Bit 1 Bit 0	
		0-3	Delta Temperature 1	
		4-7	Delta Temperature 2	
		8-11	Delta Temperature 3	
		12-15	Delta Temperature 4	
		16-19	Delta Temperature 5	
		20-23	Delta Temperature 6	
		24-27	Internal Camera Temperature	
		28-31	Spot 1 Temperature	
		32-35	Box 1 Min Temperature	
		36-39	Box 1 Max Temperature	
		40-43	Box 1 Average Temperature	
		44	Spot 1 Temperature Valid State	
		45	Box 1 Min Temperature Valid State	
		46	Box 1 Max Temperature Valid State	
		47	Box 1 Avg Temperature Valid State	
		48-51	Spot 2 Temperature	
		52-55	Box 2 Min Temperature	
		56-59	Box 2 Max Temperature	
		60-63	Box 2 Average Temperature	
		64	Spot 2 Temperature Valid State	
		65	Box 2 Min Temperature Valid State	
		66	Box 2 Max Temperature Valid State	
		67	Box 2 Avg Temperature Valid State	
		68-71	Spot 3 Temperature	
		72-75	Box 3 Min Temperature	
		76-79	Box 3 Max Temperature	
		80-83	Box 3 Average Temperature	
		84	Spot 3 Temperature Valid State	
		85	Box 3 Min Temperature Valid State	
		86	Box 3 Max Temperature Valid State	
		87	Box 3 Avg Temperature Valid State	
		88-91	Spot 4 Temperature	
		92-95	Box 4 Min Temperature	
		96-99	Box 4 Max Temperature	
		100-103	Box 4 Average Temperature	

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Input <i>0x66</i> (cont.)	3	104	Spot 4 Temperature Valid State								Get
		105	Box 4 Min Temperature Valid State								
		106	Box 4 Max Temperature Valid State								
		107	Box 4 Avg Temperature Valid State								
Input <i>0x67</i>	3	Input Data									Get
		Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
		0-3	Delta Temperature 1								
		4-7	Delta Temperature 2								
		8-11	Delta Temperature 3								
		12-15	Delta Temperature 4								
		16-19	Delta Temperature 5								
		20-23	Delta Temperature 6								
		24-27	Internal Camera Temperature								
		28-31	Spot 1 Temperature								
		32-35	Box 1 Min Temperature								
		36-39	Box 1 Max Temperature								
		40-43	Box 1 Average Temperature								
		44	Spot 1 Temperature Valid State								
		45	Box 1 Min Temperature Valid State								
		46	Box 1 Max Temperature Valid State								
		47	Box 1 Avg Temperature Valid State								
		48-51	Spot 2 Temperature								
		52-55	Box 2 Min Temperature								
		56-59	Box 2 Max Temperature								
		60-63	Box 2 Average Temperature								
		64	Spot 2 Temperature Valid State								
		65	Box 2 Min Temperature Valid State								
		66	Box 2 Max Temperature Valid State								
		67	Box 2 Avg Temperature Valid State								
		68-71	Spot 3 Temperature								
		72-75	Box 3 Min Temperature								
		76-79	Box 3 Max Temperature								
		80-83	Box 3 Average Temperature								
		84	Spot 3 Temperature Valid State								
		85	Box 3 Min Temperature Valid State								
		86	Box 3 Max Temperature Valid State								
		87	Box 3 Avg Temperature Valid State								
		88-91	Spot 4 Temperature								

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Input <i>0x67 (cont.)</i>	3	92-95	Box 4 Min Temperature						Get		
		96-99	Box 4 Max Temperature								
		100-103	Box 4 Average Temperature								
		104	Spot 4 Temperature Valid State								
		105	Box 4 Min Temperature Valid State								
		106	Box 4 Max Temperature Valid State								
		107	Box 4 Avg Temperature Valid State								
		108-127	.....Spot 5/ Box 5.....							
		128-147	.....Spot 6/ Box 6.....							
		148-167	.....Spot 7/ Box 7.....							
		168-187	.....Spot 8/ Box 8.....							
		188-207	.....Spot 9/ Box 9.....							
		208-227	.....Spot 10/ Box 10.....							
		228-247	.....Spot 11/ Box 11.....							
		248-267	.....Spot 12/ Box 12.....							
		268-287	.....Spot 13/ Box 13.....							
		288-307	.....Spot 14/ Box 14.....							
		308-327	.....Spot 15/ Box 15.....							
		328-347	.....Spot 16/ Box 16.....							
		348-367	.....Spot 17/ Box 17.....							
		368-387	.....Spot 18/ Box 18.....							
		388-407	.....Spot 19/ Box 19.....							
		408-427	.....Spot 20/ Box 20.....							
Input <i>0x68</i>	3	Input Data							Get		
		Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2		Bit 1	Bit 0
		0	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full		Force NUC	Auto NUC
		1	Disable Alarm ¹	Reserved	Image Live	Image Freeze	DI 2	DI 1		DO 2	DO 1
		2	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic		Camera Label Graphic	Enable Overlay Graphics
		3	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic		Lens Graphic	Relative Humidity Graphic
		4	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3		Alarm 2	Alarm 1
		5	Set Configuration Preset (RESERVED FOR FUTURE USE)								
		6	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved	Reserved
		7	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved		Reserved	Reserved

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

Heartbeat and Configuration Instances

Input Only Heartbeat (Instance 128 (0x80))

This instance allows clients to monitor input data without providing output data.

Listen Only Heartbeat (Instance 129 (0x81))

This instance allows clients to monitor input data without providing output data. To utilize this connection type, an owning connection must exist from a second client and the configuration of the connection must match exactly.

Configuration Instance (Unused)

Since some PLC's require a configuration instance, enter 1.

Table 2-5 Assembly Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.4 Connection Manager Object (06_{HEX}-0 Instances)

No supported services or attributes

1.5 PCCC Object (67_{HEX} - 1 Instance)

The PCCC Object has no class or instance attributes. The following tables contain common services information and PCCC Mapping parameters for the PCCC Object.

Table 1-6 PCCC Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
4B _{Hex} *	No	Yes	Execute PCCC Request

* EtherNet/IP devices use the "Execute PCCC Request" service code (4B_{Hex}) to communicate with older controllers like the PLC5E and the SLC 5/05.

Table 1-7 PCCC Object (67_{HEX}) Output Integers– Read/Write

PCCC Register	Data								Description
N10:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Output Integers (Read/Write)
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Image Live	Image Freeze	Reserved	Reserved	DO 2	DO 1	
N10:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N10:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N10:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	

Table 1-8 PCCC Object (67_{HEX}) Input Integers Little Endian– Read Only

PCCC Register	Data								Description
N11:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Little-Endian (READ ONLY)
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm ¹	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
N11:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N11:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N11:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
N11:4-5	Delta Temperature 1								
N11:6-7	Delta Temperature 2								
N11:8-9	Delta Temperature 3								
N11:10-11	Delta Temperature 4								
N11:12-13	Delta Temperature 5								
N11:14-15	Delta Temperature 6								
N11:16-17	Internal Camera Temperature								
N11:18-19	Spot 1 Temperature								
N11:20-21	Box 1 Min Temperature								
N11:22-23	Box 1 Max Temperature								
N11:24-25	Box 1 Average Temperature								

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

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PCCC Register	Data	Description
N11:26	Spot 1 Temperature Valid State	Input Integers Little-Endian (continued)
N11:27	Box 1 Min Temperature Valid State	
N11:28	Box 1 Max Temperature Valid State	
N11:29	Box 1 Avg Temperature Valid State	
N11:30-31	Spot 2 Temperature	
N11:32-33	Box 2 Min Temperature	
N11:34-35	Box 2 Max Temperature	
N11:36-37	Box 2 Average Temperature	
N11:38	Spot 2 Temperature Valid State	
N11:39	Box 2 Min Temperature Valid State	
N11:40	Box 2 Max Temperature Valid State	
N11:41	Box 2 Avg Temperature Valid State	
N11:42-43	Spot 3 Temperature	
N11:44-45	Box 3 Min Temperature	
N11:46-47	Box 3 Max Temperature	
N11:48-49	Box 3 Average Temperature	
N11:50	Spot 3 Temperature Valid State	
N11:51	Box 3 Min Temperature Valid State	
N11:52	Box 3 Max Temperature Valid State	
N11:53	Box 3 Avg Temperature Valid State	
N11:54-55	Spot 4 Temperature	
N11:56-57	Box 4 Min Temperature	
N11:58-59	Box 4 Max Temperature	
N11:60-61	Box 4 Average Temperature	
N11:62	Spot 4 Temperature Valid State	
N11:63	Box 4 Min Temperature Valid State	
N11:64	Box 4 Max Temperature Valid State	
N11:65	Box 4 Avg Temperature Valid State	
N11:66-77	.....Spot 5/ Box 5.....

PCCC Register	Data	Description
N11:78-89Spot 6/ Box 6.....	Input Integers Little-Endian (continued)
N11:90-101	.....Spot 7/ Box 7.....
N11:102-113	.....Spot 8/ Box 8.....
N11:114-125	.....Spot 9/ Box 9.....
N11:126-137	.....Spot 10/ Box 10.....
N11:138-149	.....Spot 11/ Box 11.....
N11:150-161	.....Spot 12/ Box 12.....
N11:162-173	.....Spot 13/ Box 13.....
N11:174-185	.....Spot 14/ Box 14.....
N11:186-197	.....Spot 15/ Box 15.....
N11:198-209	.....Spot 16/ Box 16.....
N11:210-221	.....Spot 17/ Box 17.....
N11:222-233	.....Spot 18/ Box 18.....
N11:234-245	.....Spot 19/ Box 19.....
N11:246-257	.....Spot 20/ Box 20.....

Table 1-9 PCCC Object (67_{HEX}) Input Integers Big Endian– Read Only

PCCC Register	Data								Description
N12:0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Big-Endian
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm ¹	Reserved	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	

¹ This alarm is the BATCH alarm. It has the ability to enable or disable all the other 8 alarms.

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PCCC Register	Data								Description
N12:1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Input Integers Big-Endian (continued)
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
N12:2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
N12:3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
N12:4-5	Delta Temperature 1								
N12:6-7	Delta Temperature 2								
N12:8-9	Delta Temperature 3								
N12:10-11	Delta Temperature 4								
N12:12-13	Delta Temperature 5								
N12:14-15	Delta Temperature 6								
N12:16-17	Internal Camera Temperature								
N12:18-19	Spot 1 Temperature								
N12:20-21	Box 1 Min Temperature								
N12:22-23	Box 1 Max Temperature								
N12:24-25	Box 1 Average Temperature								
N12:26	Spot 1 Temperature Valid State								
N12:27	Box 1 Min Temperature Valid State								
N12:28	Box 1 Max Temperature Valid State								
N12:29	Box 1 Avg Temperature Valid State								
N12:30-31	Spot 2 Temperature								
N12:32-33	Box 2 Min Temperature								
N12:34-35	Box 2 Max Temperature								
N12:36-37	Box 2 Average Temperature								

PCCC Register	Data	Description
N12:38	Spot 2 Temperature Valid State	Input Integers Big-Endian (continued)
N12:39	Box 2 Min Temperature Valid State	
N12:40	Box 2 Max Temperature Valid State	
N12:41	Box 2 Avg Temperature Valid State	
N12:42-43	Spot 3 Temperature	
N12:44-45	Box 3 Min Temperature	
N12:46-47	Box 3 Max Temperature	
N12:48-49	Box 3 Average Temperature	
N12:50	Spot 3 Temperature Valid State	
N12:51	Box 3 Min Temperature Valid State	
N12:52	Box 3 Max Temperature Valid State	
N12:53	Box 3 Avg Temperature Valid State	
N12:54-55	Spot 4 Temperature	
N12:56-57	Box 4 Min Temperature	
N12:58-59	Box 4 Max Temperature	
N12:60-61	Box 4 Average Temperature	
N12:62	Spot 4 Temperature Valid State	
N12:63	Box 4 Min Temperature Valid State	
N12:64	Box 4 Max Temperature Valid State	
N12:65	Box 4 Avg Temperature Valid State	
N12:66-77	.....Spot 5/ Box 5.....
N12:78-89	.....Spot 6/ Box 6.....
N12:90-101	.....Spot 7/ Box 7.....
N12:102-113	.....Spot 8/ Box 8.....
N12:114-125	.....Spot 9/ Box 9.....
N12:126-137	.....Spot 10/ Box 10.....
N12:138-149	.....Spot 11/ Box 11.....
N12:150-161	.....Spot 12/ Box 12.....
N12:162-173	.....Spot 13/ Box 13.....

PCCC Register	Data	Description
N12:174-185Spot 14/ Box 14.....	Input Integers Big-Endian (continued)
N12:186-197	.....Spot 15/ Box 15.....
N12:198-209	.....Spot 16/ Box 16.....
N12:210-221	.....Spot 17/ Box 17.....
N12:222-233	.....Spot 18/ Box 18.....
N12:234-245	.....Spot 19/ Box 19.....
N12:246-257	.....Spot 20/ Box 20.....

Table 1-10 PCCC Object (67_{HEX}) Input Floats– Read Only

PCCC Register	Data	Description
F13:0	Delta Temperature 1	Input Floats (READ ONLY)
F13:1	Delta Temperature 2	
F13:2	Delta Temperature 3	
F13:3	Delta Temperature 4	
F13:4	Delta Temperature 5	
F13:5	Delta Temperature 6	
F13:6	Internal Camera Temperature	
F13:7	Spot 1 Temperature	
F13:8	Box 1 Min Temperature	
F13:9	Box 1 Max Temperature	
F13:10	Box 1 Average Temperature	
F13:11	Spot 2 Temperature	
F13:12	Box 2 Min Temperature	
F13:13	Box 2 Max Temperature	
F13:14	Box 2 Average Temperature	
F13:15	Spot 3 Temperature	
F13:16	Box 3 Min Temperature	

PCCC Register	Data	Description
F13:17	Box 3 Max Temperature	Input Floats (continued)
F13:18	Box 3 Average Temperature	
F13:19	Spot 4 Temperature	
F13:20	Box 4 Min Temperature	
F13:21	Box 4 Max Temperature	
F13:22	Box 4 Average Temperature	
F13:23-26	.....Spot 5/ Box 5.....
F13:27-30	.....Spot 6/ Box 6.....
F13:31-34	.....Spot 7/ Box 7.....
F13:35-38	.....Spot 8/ Box 8.....
F13:39-42	.....Spot 9/ Box 9.....
F13:43-46	.....Spot 10/ Box 10.....
F13:47-50	.....Spot 11/ Box 11.....
F13:51-54	.....Spot 12/ Box 12.....
F13:55-58	.....Spot 13/ Box 13.....
F13:59-62	.....Spot 14/ Box 14.....
F13:63-66	.....Spot 15/ Box 15.....
F13:67-70	.....Spot 16/ Box 16.....
F13:71-74	.....Spot 17/ Box 17.....
F13:75-78	.....Spot 18/ Box 18.....
F13:79-82	.....Spot 19/ Box 19.....
F13:83-86	.....Spot 20/ Box 20.....

For additional PCCC mappings, refer to Appendix A

1.6 TCP Object (F5hex- 1 instance)

The following tables contain the attribute and common services information for the TCP Object.

Table 2-11 TCP Object (F5_{HEX}- 1 Instance)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	4	Get
Instance 1	1	Status*	DWORD	1	Get
	2	Configuration capability*	DWORD	0	Get
	3	Configuration control*	DWORD	0	Get
	4	Physical Link Object * Structure of Path Size Path	UINT Array of Word	2 0x20F6 0x2401	Get
	5	Interface configuration* Structure of IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name Size Domain Name	UDINT UDINT UDINT UDINT UDINT UINT STRING	0 0 0 0 0 0 0	Get
	6	Host name* Structure of Host Name Size Host Name	UINT STRING	0 0	Get

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-3.2 from ODVA.

Table 2-12 TCP Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.7 Ethernet Link Object (F6_{HEX} - 1 Instance)

The following tables contain the attribute and common services information for the Ethernet Link Object.

Table 2-13 Ethernet Link Object (F6_{HEX} - 1 Instance)

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule
Class (Instance 0)	1	Revision	UINT	3	Get
Instance 1	1	Interface speed*	UDINT	100	Get
	2	Interface flags*	DWORD	3	Get
	3	Physical address	USINT Array (6)	0	Get

* For more details on these attributes, see *Volume 2: EtherNet/IP Adaptation of CIP*, Section 5-4.2 from ODVA.

Table 2-14 Ethernet Link Object's common services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single

1.8 System Command Object (64_{HEX}-1 Instance)

1.8.1 Class and Instance Attributes

The following tables contain the attribute and common services information for System Command Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Camera Distance Units	SHORT STRING32	“feet”, “meter”	Get/Set	
	2	Camera Temperature Units	SHORT STRING32	“C”: Celsius “F”: Fahrenheit	Get/Set	
	3	Current Preset Profile	USINT		Get/Set	For now will always return Error Code

1.8.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.8.3 Description of Instance Attributes

1.8.3-1 Camera Distance Units

This attribute sets the display units for measuring distance within IR Monitor ONLY. Acceptable unit values are “Feet” and “Meter”.

1.8.3-2 Camera Temperature Units

This attribute sets the display units for measuring temperature within IR Monitor ONLY. Acceptable unit values are “C” for Celsius and “F” for Fahrenheit.

1.8.3-3 Current Preset Profile

The attribute is reserved for future expansion and has no effect on the camera.

1.9 Camera Control Command Object (65_{HEX}- 1 Instance)

1.9.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Camera Control Command Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Auto NUC	BOOL	0: Disable 1: Enable	Get/Set	
	2	Force NUC *	BOOL	0: Do Nothing 1: Execute	Get/Set	
	3	Full Auto Focus *	BOOL	0: Do Nothing 1: Full Auto Focus	Get/Set	N/A for FLIR Ax8
	4	Fast Auto Focus *	BOOL	0: Do Nothing 1: Fast Auto Focus	Get/Set	N/A for FLIR Ax8
	5	Focus Control Speed	USINT	0-100	Get/Set	N/A for FLIR Ax8
	6	Focus Control	USINT	0: Do Nothing 1: Near (-) 2: Far (+)	Get/Set	N/A for FLIR Ax8
	7	Focus Position	DINT	0-max	Get/Set	N/A for FLIR Ax8
	8	Digital Zoom	REAL	1.0-8.0	Get/Set	
	9	Enable Overlay Graphics	BOOL	0: Disable 1: Enable	Get/Set	
	10	Overlay Graphic Camera Label	BOOL	0: Off 1: On	Get/Set	
	11	Overlay Graphic Scale	BOOL	0: Off 1: On	Get/Set	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	12	Overlay Graphic Date/Time	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	13	Overlay Graphic Emissivity	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	14	Overlay Graphic Distance	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	15	Overlay Graphic Reflected Temp.	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	16	Overlay Graphic Atmospheric Temp.	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	17	Overlay Graphic Relative Humidity	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	18	Overlay Graphic Lens	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8
	19	Overlay Graphic Measurement Mask	BOOL	0: Off 1: On	Get/Set	N/A for FLIR Ax8

*Momentary Toggle- Read will always return 0

1.9.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.9.3 Description of Instance Attributes

1.9.3-1 Auto NUC

This attribute either enables or disables the Auto NUC functionality in the camera. NUC stands for non-uniformity correction. If this attribute is enabled, the camera will auto-correct whenever necessary. If disabled, the camera will rely on the user to force an Auto NUC when needed, see 1.9.3-2.

1.9.3-2 Force NUC

This attribute forces a NUC to execute. Since this is a momentary toggle, the read will always return 0.

1.9.3-3 Full Auto Focus

This attribute forces a coarse autofocus to execute using the entire focus range. Since this is a momentary toggle, the read will always return 0.

1.9.3-4 Fast Auto Focus

This attribute forces a fine autofocus to execute using the nearby focus range. Since this is a momentary toggle, the read will always return 0.

1.9.3-5 Focus Control Speed

This attribute sets the step value for a focus. The acceptable range for this attribute is 0-100. A value of 0 indicates no change, 1 is the smallest focus step change possible, and 100 is the largest focus step change possible. Once the step change is set here, the Focus command is executed by Attribute 6, see 1.9.3-6 for more details.

1.9.3-6 Focus Control

This attribute depends on the values of Attribute 5. If a 0 is written, no change will occur. If a 1 is written, the refocus will move towards near focus for the amount given in Attribute 5. If a 2 is written, the refocus will move towards far focus for the amount given in Attribute 5. All other the values are not accepted.

1.9.3-7 Focus Position

This attribute forces the camera to refocus to the absolute position provided. The range of values depends on the camera.

1.9.3-8 Digital Zoom

This attribute controls the digital zoom factor in the camera. The acceptable range of values is 1.0-8.0, where 1.0 is the lowest zoom factor and 8.0 is the highest zoom factor.

1.9.3-9 Enable Overlay Graphics

This attribute either shows or hides the enabled overlay graphic options (Attributes 10-19) in IR Monitor. If this is disabled, it will also hide any spot or box temperature information as well.

1.9.3-10 Overlay Graphic Camera Label

This attribute either enables or disables the overlay camera label graphic in IR Monitor.

1.9.3-11 Overlay Graphic Scale

This attribute either enables or disables the overlay camera scale graphic in IR Monitor.

1.9.3-12 Overlay Graphic Date/Time

This attribute either enables or disables the overlay camera date and time graphic in IR Monitor.

1.9.3-13 Overlay Graphic Emissivity

This attribute either enables or disables the overlay camera emissivity graphic in IR Monitor.

1.9.3-14 Overlay Graphic Distance

This attribute either enables or disables the overlay camera distance graphic in IR Monitor.

1.9.3-15 Overlay Graphic Reflected Temp.

This attribute either enables or disables the overlay camera reflected temperature graphic in IR Monitor.

1.9.3-16 Overlay Graphic Atmospheric Temp.

This attribute either enables or disables the overlay camera atmospheric temperature graphic in IR Monitor.

1.9.3-17 Overlay Graphic Relative Humidity

This attribute either enables or disables the overlay camera relative humidity graphic in IR Monitor.

1.9.3-18 Overlay Graphic Lens

This attribute either enables or disables the overlay camera lens graphic in IR Monitor.

1.9.3-19 Overlay Graphic Measurement Mask

This attribute either enables or disables the overlay camera measurement mask graphic in IR Monitor.

1.10 Temperature Control Object (66_{HEX}-n Instances)

1.10.1 Class and Instance Attributes

The following tables contain the attribute and common services information for the Temperature Control Object.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
	100	Lens name	SHORT STRING32		Get	
	101	Write Lens ID to “.le”	SHORT STRING32		Get/Set	
	102	Write “ds” to “.image.ccase.query.ds”	SHORT STRING32		Get/Set	
	103	Write “ap” to “.image.ccase.query.ap”	SHORT STRING32		Get/Set	
	104	Write “fi” to “.image.ccase.query.fi”	SHORT STRING32		Get/Set	
	105	Case Query	SHORT STRING32		Get	
	106	Current Temp. Range Case	SHORT STRING32		Get/Set	
	107	Change Temperature Case *	BOOL	0:Do Nothing 1:Execute	Get/Set	
Instance 1-n						
	1	Current Upper Limit Temp.	REAL	Kelvin	Get	
	2	Current Lower Limit Temp.	REAL	Kelvin	Get	
	3	Case Enabled	BOOL	0: No 1: Yes	Get	

*Momentary Toggle- Read will always return 0

1.10.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	Yes	No	Set_Attribute_Single

1.10.3 Description of Class Attributes

In order for the lens query, get current lens case, or change current lens case to work properly, follow these steps:

- Read Class Attribute 100
Note: The string from the Class 100 Attribute consists of a resource path and the Lens id. The path should not be a part of the Lens id when used in Class Attribute 101. The Lens id is the suffix string from the last dot, ie: ".node1.node2.<LensID>"
- Write the lens id received from Class Attribute 100 to Class Attribute 101
- Write the string "ds" to Class Attribute 102
- Write the string "ap" to Class Attribute 103
- Write the string "fi" to Class Attribute 104
- Read Class Attribute 105 to query the lens cases
- To change the current lens, write the desired lens case to Class Attribute 106 and then write a 1 to Class Attribute 107 to execute the change
- To read the current lens case, read Class Attribute 106

1.10.3-1 Max Instance

This attribute will show the number of temperature cases that are configured in the camera. This value will only be calculated after Attribute 105 is called for the first time (see 1.10.3-7 for more information), otherwise the value will stay at 0.

1.10.3-2 Lens Name

This attribute will output the name of the lens configured in the camera in a string.

1.10.3-3 Write Lens Id to ".le"

Take the response from Attribute 100 (Lens Name), and write this string into this attribute. For example, if the Lens Name returned "leE" or 0x6C 0x65 0x45, then you must write 0x03 0x6C 0x65 0x45 into this attribute (with the length of the string as the first byte).

1.10.3-4 Write “ds” to “.image.ccase.query.ds”

Write the string “ds” into this attribute. Write 0x02 0x64 0x73 (the length of the string is in the first byte).

1.10.3-5 Write “ap” to “.image.ccase.query.ap”

Write the string “ap” into this attribute. Write 0x02 0x61 0x70 (the length of the string is in the first byte).

1.10.3-6 Write “fi” to “.image.ccase.query.fi”

Write the string “fi” into this attribute. Write 0x02 0x66 0x69 (the length of the string is in the first byte).

1.10.3-7 Case Query

This attribute will display the lens cases currently configured in the camera. For example, a response of 0x04 0x20 0x30 0x20 0x31 means that cases 0 and 1 have been found.

1.10.3-8 Current Temperature Range Case

This attribute will display the current temperature range case selected in the camera. To change the temperature range case, you must first write the new temperature case in this attribute and then execute Attribute 107 (see 1.10.3-9).

1.10.3-9 Change Temperature Case

If a 0 is written, no change will occur. If a 1 is written, the current temperature range case will be overwritten by the case assigned to Attribute 106 (see 1.10.3-8). Since this is a momentary toggle, the read will always return 0.

1.10.4 Description of Instance Attributes

Instance 1 corresponds to Case 0, Instance 2 corresponds to Case 1, etc...

1.10.4-1 Current Upper Limit Temperature

This attribute returns the upper limit temperature for a particular lens case in Kelvin.

1.10.4-2 Current Lower Limit Temperature

This attribute returns the lower limit temperature for a particular lens case in Kelvin.

1.10.4-3 Case Enabled

This attribute returns a value of 1 if this lens case has been calibrated for the camera, and returns a value of 0 if this lens case does not exist in the camera.

1.11 Image Control Commands Object (67_{HEX}-1 Instance)

1.11.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Image Control Commands

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Palette	SHORT STRING32	“bw.pal” “iron.pal” “rainbox.pal”	Get/Set	
	2	Palette Invert	BOOL	0: Normal 1: Reverse	Get/Set	
	3	Quality	USINT	0: High (7) 1: Normal (20) 2: Low (31)	Get/Set	
	4	Image Automatic Adjust	SHORT STRING32	“Auto”, “Manual”	Get/Set	
	5	Scale Min	REAL	Kelvin	Get/Set	
	6	Scale Max	REAL	Kelvin	Get/Set	
	7	Span	REAL	Kelvin	Get/Set	
	8	Level	REAL	Kelvin	Get/Set	
	9	One Time Image Auto Adjust *	BOOL	0: Do Nothing 1: Execute	Get/Set	
	10	Image Adjust Method	SHORT STRING32	“Linear”, “Histogram”	Get/Set	
	11	Image Freeze	BOOL	0: Off 1: On	Get/Set	
	12	Image Live	BOOL	0: Off 1: On	Get/Set	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	13	Image State	SHORT STRING32	“LIVE”, “FREEZE”	Get	
	14	Image Measure Mode	BOOL	0:Normal 1:High Prio One Shot	Get/Set	
	15	Image Measurement One Shot *	BOOL	0: Do Nothing 1:Execute	Get/Set	

*Momentary Toggle- Read will always return 0

1.11.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.11.3 Description of Instance Attributes

1.11.3-1 Palette

This attribute sets the current color palette setting for the camera. The default palette choices set up in the camera are “bw.pal”, “iron.pal”, and “rainbow.pal”.

1.11.3-2 Palette Invert

This attribute either enables or disables the invert palette option in the camera. A value of 1 indicates that the palette colors will be inverted.

1.11.3-3 Quality

This attribute controls the quality of the image resolution in IR Monitor. A value of 0 indicates a high video quality. A value of 1 indicates a normal video quality. A value of 2 indicates a low video quality.

1.11.3-4 Image Automatic Adjust

This attribute controls whether the overall scale temperature range will be automatically updated around the temperatures being read, or the range will only be updated if the user has to send a manual request in Attribute 9 to update.

1.11.3-5 Scale Min

This attribute sets the value of the minimum temperature scale setting in Kelvin. This setting is used in conjunction with Attribute 6 and is only effective if Attribute 4 is set to Manual.

1.11.3-6 Scale Max

This attribute sets the value of the maximum temperature scale setting in Kelvin. This setting is used in conjunction with Attribute 5 and is only effective if Attribute 4 is set to Manual.

1.11.3-7 Span

This attribute sets the value of the temperature scale span setting in Kelvin. This setting is used in conjunction with Attribute 8 and is only effective if Attribute 4 is set to Manual.

1.11.3-8 Level

This attribute sets the center of the temperature scale span setting in Kelvin. This setting is used in conjunction with Attribute 7 and is only effective if Attribute 4 is set to Manual.

1.11.3-9 One Time Image Auto Adjust

This attribute forces the scale temperature ranges to be updated. This setting is only effective if Attribute 4 is set to Manual.

1.11.3-10 Image Adjust Method

This attribute sets the method used to distribute the image colors. Acceptable values are “Linear” and “Histogram”. This setting is only effective if Attribute 4 is set to Manual.

1.11.3-11 Image Freeze

This attribute sets the image stream to freeze or stop continuous streaming.

1.11.3-12 Image Live

This attribute sets the image stream to start continuous streaming.

1.11.3-13 Image State

This attribute displays whether the image stream state is set to “Freeze” or “Live”.

1.11.3-14 Image Measure Mode

This attribute controls when the temperature values are to be updated. Set to 1 if you want to control when the temperatures are updated only when Attribute 15 is executed. Set to 0 if temperatures are to be read and updated continuously.

1.11.3-15 Image Measurement One Shot

This attribute executes a command to update the temperature value readings. This setting is only effective if Attribute 14 is set to 1.

1.12 Isotherm Control Commands Object (68_{HEX}.1 Instance)**1.12.1 Class and Instance Attributes**

The following tables contain the attribute and common services information for Isotherm Control Commands

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1						
	1	Isotherm Enable	BOOL	0: Off 1: On	Get/Set	
	2	Isotherm Type	SHORT STRING32	“Above” “Below”	Get/Set	
	3	Isotherm Level	REAL	Kelvin	Get/Set	
	4	Isotherm Color	SHORT STRING32	“palette1” “palette2” “red” “green” “blue” “yellow” “cyan” “magenta” “gray”	Get/Set	

1.12.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.12.3 Description of Class Attributes

Currently the camera is only enabled for one isotherm. In the future, there may be future instances for additional isotherms.

1.12.3-1 Max Instance

This attribute indicates how many isotherms are enabled in the camera and can be used.

1.12.4 Description of Instance Attributes

Currently the camera is only enabled for one isotherm. In the future, there may be future instances for additional isotherms.

1.12.4.1 Isotherm Enable

This attribute enables the isotherm control.

1.12.4.2 Isotherm Type

This attribute sets the type of the isotherm control. As of now, the acceptable values are “Below” and “Above”.

1.12.4.3 Isotherm Level

This attribute sets the value of the isotherm low temperature limit in Kelvin.

1.12.4.4 Isotherm Color

This attribute sets the color of the isotherm. Acceptable values are “palette1”, “palette2”, “red”, “green”, “blue”, “yellow”, “cyan”, “magenta”, and “gray”.

1.13 Image File Storage Object (69_{HEX}- 1 Instance)

1.13.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Image File Storage.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Store Image to Camera Memory *	BOOL	0: Do Nothing 1: Execute	Get/Set	Ax8: Saves images to directory /FLIR/images

*Momentary Toggle- Read will always return 0

1.13.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.13.3 Description of Instance Attributes

1.13.3-1 Store Image to Camera Memory

The image will be stored under the \Temp\images\ directory in the FLIR A310 camera and under the /FLIR/images/ directory for FLIR Ax8. The image file name will be automatically created and is made up of the date and time to ensure a unique name with each image store. Since this is a momentary toggle, the read will always return 0. When power is cycled to the camera, the images in this folder will be deleted (A310). You may copy these files out of the camera by using ftp (A310) or sftp (Ax8).

1.14 Alarm Settings Object (6A_{HEX}- 9 Instances)

1.14.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Alarm Settings

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 8						
	1	Alarm Status	BOOL	0: Off 1: On	Get	
Instance 9						
	1	Alarm Status	BOOL	0: Off 1: On	Get	

1.14.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single

1.14.3 Description of Class Attributes

Currently the camera is enabled for nine alarms. In the future, there may be more.

1.14.3-1 Max Instance

This attribute indicates how many alarms are enabled in the camera and can be used.

1.14.4 Description of Instance Attributes

Each instance corresponds to a different Alarm within the camera. Instance 1 is Alarm 1, Instance 2 is Alarm 2, etc.... Instance 9 is the Batch Alarm. The Batch Alarm is used to enable and disable the output of the other active alarms.

1.14.4-1 Alarm Status

This attribute displays whether an alarm condition state is active or not.

1.15 Object Parameters Object (6B_{HEX}- 1 Instance)

1.15.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Object Parameters.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	Atmosphere Temperature	REAL	Kelvin	Get/Set	
	2	Emissivity	REAL	0.001-1.0	Get/Set	
	3	Distance	REAL	Meters	Get/Set	
	4	Reflected Temp	REAL	Kelvin	Get/Set	
	5	Relative Humidity	REAL	0.0-1.0	Get/Set	
	6	Window Transmission Rate	REAL	0.001-1.0	Get/Set	
	7	Window Temperature	REAL	Kelvin	Get/Set	

1.15.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.15.3 Description of Instance Attributes

1.15.3-1 Atmosphere Temperature

This attribute sets the value of atmospheric temperature in Kelvin.

1.15.3-2 Emissivity

This attribute sets the value of object emissivity. Accepted range is from 0.001 to 1.0.

1.15.3-3 Distance

This attribute sets the value of the distance to the object in Meters.

1.15.3-4 Reflected Temperature

This attribute sets the value of the object temperature surroundings in Kelvin.

1.15.3-5 Relative Humidity

This attribute sets the relative humidity value of the air. Accepted range is from 0.0 to 1.0. A value of 0.30 represents 30% humidity.

1.15.3-6 Window Transmission Rate

This attribute sets the value of the External Optics transmission. Accepted range is from 0.001 to 1.0. Set to 1.0 if no external optics is present.

1.15.3-7 Window Temperature

This attribute sets the value of the External Optics temperature in Kelvin. Commonly used for heat shields, close-up lenses, etc.

1.16 Spot Meter Object (6C_{HEX}- 20 Instances)

1.16.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Spot Meter.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 20						
	1	Enable Local Object Parameter Values	BOOL	0: Disabled 1: Enabled	Get/Set	
	2	Reflected Temp.	REAL	Kelvin	Get/Set	
	3	Emissivity	REAL	0.001-1.0	Get/Set	
	4	Distance	REAL	Meters	Get/Set	
	5	Enable Spotmeter	BOOL	0:Disable 1:Enable	Get/Set	
	6	Spotmeter Pixel X- Position	DINT		Get/Set	
	7	Spotmeter Pixel Y- Position	DINT		Get/Set	
	8	Spotmeter Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	9	Spotmeter Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compensated with delta correction(d)	Get	

1.16.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.16.3 Description of Class Attributes

Currently the camera is enabled for 10 spotmeters (A310) or 5 spotmeters (Ax8).

1.16.3-1 Max Instance

This attribute indicates how many spotmeter objects are enabled in the camera and can be used.

1.16.4 Description of Instance Attributes

1.16.4-1 Enable Local Object Parameter Values

When this attribute is set to enabled (1), that spot uses the Reflected Temperature, Emissivity, and Distance values in Attributes 2, 3 and 4 rather than the global object parameter values in Object 0x6B.

1.16.4-2 Reflected Temperature

This attribute sets the value of a particular spot's temperature surroundings in Kelvin. Only used when Attribute 1 is set to 1.

1.16.4-3 Emissivity

This attribute sets the value of a particular spot's emissivity. Accepted range is from 0.001 to 1.0. Only used when Attribute 1 is set to 1.

1.16.4-4 Distance

This attribute sets the value of the distance to a particular spot object in Meters. Only used when Attribute 1 is set to 1.

1.16.4-5 Enable Spotmeter

This attribute either enables (1) or disables (0) a particular spotmeter.

1.16.4-6 Spotmeter Pixel X-Position

This attribute sets the value of a particular spot's position on the X-axis. The X-axis is horizontal. As this number increases from 0, the spotmeter will move from left to right.

1.16.4-7 Spotmeter Pixel Y-Position

This attribute sets the value of a particular spot's position on the Y-axis. The Y-axis is vertical. As this number increases from 0, the spotmeter will move from top to bottom.

1.16.4-8 Spotmeter Temperature

This attribute displays the spotmeter's temperature value in Kelvin.

1.16.4-9 Spotmeter Temperature State

This attribute displays the spotmeter's temperature state. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17 Box Object (6D_{HEX}-20 Instances)

1.17.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Box.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
Instance 1 - 20						
	1	Enable Local Object Parameter Values	BOOL	0: Disabled 1: Enabled	Get/Set	
	2	Reflected Temp.	REAL	Kelvin	Get/Set	
	3	Emissivity	REAL	0.001-1.0	Get/Set	
	4	Distance	REAL	Meters	Get/Set	
	5	Enable Box	BOOL	0:Disable 1:Enable	Get/Set	
	6	Box Min Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	7	Box Min Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compensated with delta correction(d)	Get	
	8	Box Max Temp.	REAL	Kelvin	Get	
	9	Box Max Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compensated with delta correction(d)	Get	
	10	Box Avg. Temp.	REAL	Kelvin	Get	

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
	11	Box Avg. Temp. State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated with delta correction(d)	Get	
	12	Box Position X	DINT		Get/Set	
	13	Box Position Y	DINT		Get/Set	
	14	Box Min Temp. Position X	DINT		Get	
	15	Box Min Temp. Position Y	DINT		Get	
	16	Box Max Temp. Position X	DINT		Get	
	17	Box Max Temp. Position Y	DINT		Get	
	18	Box Width	DINT		Get/Set	
	19	Box Height	DINT		Get/Set	
	20	Temp. Display Options	USINT	Bit 0: Display Max Temp. Bit 1: Display Min Temp. Bit 2: Display Avg Temp.	Get/Set	

1.17.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.17.3 Description of Class Attributes

Currently the camera is enabled for 10 boxes. In the future, there may be more.

1.17.3-1 Max Instance

This attribute indicates how many box objects are enabled in the camera and can be used.

1.17.4 Description of Instance Attributes**1.17.4-1 Enable Local Object Parameter Values**

When this attribute is set to enabled (1), that box uses the Reflected Temperature, Emissivity, and Distance values in Attributes 2, 3 and 4 rather than the global object parameter values in Object 0x6B.

1.17.4-2 Reflected Temperature

This attribute sets the value of a particular box's temperature surroundings in Kelvin. Only used when Attribute 1 is set to 1.

1.17.4-3 Emissivity

This attribute sets the value of a particular box's emissivity. Accepted range is from 0.001 to 1.0. Only used when Attribute 1 is set to 1.

1.17.4-4 Distance

This attribute sets the value of the distance to a particular box object in Meters. Only used when Attribute 1 is set to 1.

1.17.4-5 Enable Box

This attribute either enables (1) or disables (0) a particular box.

1.17.4-6 Box Min Temperature

This attribute displays the lowest temperature value in a particular box in Kelvin.

1.17.4-7 Box Min Temperature State

This attribute displays the temperature state of a box's minimum value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-8 Box Max Temperature

This attribute displays the highest temperature value in a particular box in Kelvin.

1.17.4-9 Box Max Temperature State

This attribute displays the temperature state of a box's maximum value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-10 Box Average Temperature

This attribute displays the average temperature value in a particular box in Kelvin.

1.17.4-11 Box Average Temperature State

This attribute displays the temperature state of a box's average value. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.17.4-12 Box Position X

This attribute sets the value of a particular box's position on the X-axis. The X-axis is horizontal. As this number increases from 0, the box will move from left to right.

1.17.4-13 Box Position Y

This attribute sets the value of a particular box's position on the Y-axis. The Y-axis is vertical. As this number increases from 0, the box will move from top to bottom.

1.17.4-14 Box Min Temperature Position X

This attribute indicates where on the horizontal X-axis the minimum box temperature is located.

1.17.4-15 Box Min Temperature Position Y

This attribute indicates where on the vertical Y-axis the minimum box temperature is located.

1.17.4-16 Box Max Temperature Position X

This attribute indicates where on the horizontal X-axis the maximum box temperature is located.

1.17.4-17 Box Max Temperature Position Y

This attribute indicates where on the vertical Y-axis the maximum box temperature is located.

1.17.4-18 Box Width

This attribute sets the value of a particular box's width.

1.17.4-19 Box Height

This attribute sets the value of a particular box's height.

1.17.4-20 Temperature Display Options

This attribute controls which temperatures will be shown on IR Monitor for a particular box. When a particular bit is set to 1, then that assigned temperature display value will be shown on IR Monitor. Acceptable range is 0 (none shown) - 7 (all shown).

1.18 Temperature Difference Object (6E_{HEX} - 6 Instances)

1.18.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
	2	Max Instance	UINT		Get	
	100	Internal Camera Temp.	REAL		Get	
Instance 1-6						
	1	Enable Temp. Difference	BOOL	0:Disable 1: Enable	Get/Set	
	2	Value of Temp. Difference	REAL	Kelvin	Get	
	3	Difference Temp. Valid State	USINT	0: Undefined(U) 1: Valid (=) 2: Less Than(>) 3: More Than(<) 4: Outside(O) 5: Outside calib.(*) 6: Unstable(~) 7: Compenstated w/ delta correction(d)	Get	

1.18.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.18.3 Description of Class Attributes

Currently the camera is enabled for six boxes. In the future, there may be more.

1.18.3-1 Max Instance

This attribute indicates how many box objects are enabled in the camera and can be used.

1.18.3-2 Internal Camera Temperature

This attribute indicates the internal temperature of the camera in Kelvin.

1.18.4 Description of Instance Attributes

1.18.4-1 Enable Temperature Difference

This attribute either enables (1) or disables (0) a particular temperature difference instance.

1.18.4-2 Value of Temperature Difference

This attribute indicates the temperature difference of a particular temperature difference value set up in the camera in Kelvin.

1.18.4-3 Difference Temperature Valid State

This attribute displays the difference temperature's state. The following table shows the different values and their meanings:

Value	Meaning
0	Undefined
1	In the acceptable range
2	Less than the acceptable range
3	More than the acceptable range
4	Outside the acceptable range
5	Outside calibration
6	Unstable temperature
7	Temperature is compensated with delta correction

1.19 Physical I/O Object (6F_{HEX} - 1 Instance)

1.19.1 Class and Instance Attributes

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	
Instance 1						
	1	DI 1	BOOL	0:Off 1:On	Get	
	2	DI 2	BOOL	0:Off 1:On	Get	N/A for FLIR Ax8
	101	DO 1	BOOL	0:Low 1:High	Get/Set	
	102	DO 2	BOOL	0:Low 1:High	Get/Set	N/A for FLIR Ax8

1.19.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
0E _{Hex}	Yes	Yes	Get_Attribute_Single
10 _{Hex}	No	Yes	Set_Attribute_Single

1.19.3 Description of Instance Attributes

1.19.3-1 DI 1

This attribute indicates if Digital Input 1 is active (1) or inactive (0).

1.19.3-2 DI 2

This attribute indicates if Digital Input 2 is active (1) or inactive (0).

1.19.3-3 DO 1

This attribute either sets the Digital Output 1 to an active (1) or inactive (0) state.

1.19.3-4 DO 2

This attribute either sets the Digital Output 2 to an active (1) or inactive (0) state.

1.20 Pass Through Object (70_{HEX} - 1 Instance)**1.20.1 Class and Instance Attributes**

The following tables contain the attribute and common services information for Temperature Difference.

Instance	Attribute ID	Name	Data Type	Data Value	Access Rule	Comment
Class (Instance 0)	1	Revision	UINT	1	Get	

1.20.2 Class and Instance Services

Service code	Implemented for		Service name
	Class level	Instance level	
32 _{Hex}	No	Yes	Read_BOOL
33 _{Hex}	No	Yes	Write_BOOL
34 _{Hex}	No	Yes	Read_INT32
35 _{Hex}	No	Yes	Write_INT32
36 _{Hex}	No	Yes	Read_DOUBLE
37 _{Hex}	No	Yes	Write_DOUBLE
38 _{Hex}	No	Yes	Read_ASCII
39 _{Hex}	No	Yes	Write_ASCII

Example using Service Code 0x32:

Goal: Read Status of Digital Input

Explanation: Data field is filled with the length of the camera variable “.power.states.digin1” followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x32	0x70	0x01		14 2E 70 6F 77 65 72 2E 73 74 61 74 65 73 2E 64 69 67 69 6E 31

Example using Service Code 0x33:

Goal: Force an Auto Nuc on the camera

Explanation: Data field is filled with the length of the camera variable “.image.services.nuc.commit” followed by the ASCII representation of it, plus an additional byte of data (in this case 0x01) for the new BOOLEAN value.

Service Code	Class	Instance	Attribute	Data
0x33	0x70	0x01		1A 2E 69 6D 61 67 65 2E 73 65 72 76 69 63 65 73 2E 6E 75 63 2E 63 6F 6D 6D 69 74 01

Example using Service Code 0x34:

Goal: Read Focus Position Value

Explanation: Data field is filled with the length of the camera variable “.system.focus.position” followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x34	0x70	0x01		16 2E 73 79 73 74 65 6D 2E 66 6F 63 75 73 2E 70 6F 73 69 74 69 6F 6E

Example using Service Code 0x35:

Goal: Write Focus Position Value to 125

Explanation: Data field is filled with the length of the camera variable “.system.focus.position” followed by the ASCII representation of it, plus 4 additional bytes of data (in this case 0x7D 0x00 0x00 0x00) for the new INT32 value. The new value should be passed in Little-Endian to match EtherNet/IP. This means that the bytes are placed in order from least significant to most significant.

Service Code	Class	Instance	Attribute	Data
0x35	0x70	0x01		16 2E 73 79 73 74 65 6D 2E 66 6F 63 75 73 2E 70 6F 73 69 74 69 6F 6E 7D 00 00 00

Example using Service Code 0x36:

Goal: Read Zoom Factor Value

Explanation: Data field is filled with the length of the camera variable “.image.zoom.zoomFactor” followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x36	0x70	0x01		16 2E 69 6D 61 67 65 2E 7A 6F 6F 6D 2E 7A 6F 6F 6D 46 61 63 74 6F 72

Example using Service Code 0x37:

Goal: Write Focus Position Value to 8.0

Explanation: Data field is filled with the length of the camera variable “.image.zoom.zoomFactor” followed by the ASCII representation of it, plus 4 additional bytes of data (in this case 0x00 0x00 0x00 0x41) for the new REAL value. The new value should be passed in Little-Endian to match EtherNet/IP. This means that the bytes are placed in order from least significant to most significant.

Service Code	Class	Instance	Attribute	Data
0x37	0x70	0x01		16 2E 69 6D 61 67 65 2E 7A 6F 6F 6D 2E 7A 6F 6F 6D 46 61 63 74 6F 72 00 00 00 41

Example using Service Code 0x38:

Goal: Read Image Automatic Adjust Setting

Explanation: Data field is filled with the length of the camera variable “.image.contadj.adjMode” followed by the ASCII representation of it.

Service Code	Class	Instance	Attribute	Data
0x38	0x70	0x01		16 2E 69 6D 61 67 65 2E 63 6F 6E 74 61 64 6A 2E 61 64 6A 4D 6F 64 65

Example using Service Code 0x39:

Goal: Write Image Automatic Adjust Setting to “Auto”

Explanation: Data field is filled with the length of the camera variable “.image.contadj.adjMode” followed by the ASCII representation of it. The next byte of data is the size of the new ASCII string value to follow (in this case 0x04). Then, attach the new ASCII value (in this case “0x41 0x75 0x74 0x6F”).

Service Code	Class	Instance	Attribute	Data
0x39	0x70	0x01		16 2E 69 6D 61 67 65 2E 63 6F 6E 74 61 64 6A 2E 61 64 6A 4D 6F 64 65 04 41 75 74 6F

Appendix A – Additional PCCC Mappings

EtherNet/IP Objects 0x64 through 0x6F are also available to access using PCCC.

Additional Integer (N) mappings

To access integer (N) mappings of Objects 0x64-0x6F use the following information:

1. The file number is the same as the decimal value of the EtherNet/IP Object number.
2. The file offset can be calculated using the following formula:

$$\text{Beginning File Offset} = ((\text{Instance\#} * 4000) + ((\text{Attribute\#} - 1) * 20) + 1)$$
3. Each attribute is allocated a length of 20 for the value. You can read/write a maximum length of 20 at a time if the read or write begins from **Beginning File Offset**.
4. The first value of the length is reserved for the length (in bytes) for the data value.
5. If a value is writeable, then the new value will be displayed when read next, else there was an error.
6. If value is a DINT or REAL data type, then the following will happen:
 - a. Number of bytes will be in (**Beginning File Offset**)
 - b. Value in Little-Endian format will be in (**Beginning File Offset +1**) and (**Beginning File Offset +2**)
 - c. Number of bytes again will be in (**Beginning File Offset +3**)
 - d. Value in Big-Endian format will be in (**Beginning File Offset +4**) and (**Beginning File Offset +5**)
7. If a value is writeable and you are starting from **Beginning File Offset**, the length field is ONLY REQUIRED when changing a STRING data type.

Example reading Box 2 Min Temperature:

- File Number = 109
- Beginning File Offset = 8101
- Example Min Temperature is 302.25 Kelvin

N109:8101 = 4
 N109:8102 = 0x2000
 N109:8103 = 0x4397
 N109:8104 = 4
 N109:8105 = 0x4397
 N109:8106 = 0x2000

Additional Float (F) mappings

To access Float (F) mappings of Objects 0x64-0x6F use the following information:

1. The file number can be calculated using the following formula:
$$\text{File Number} = (\text{Object\#} + 100)$$
2. The file offset can be calculated using the following formula:
$$\text{Beginning File Offset} = ((\text{Instance\#} * 4000) + ((\text{Attribute\#} - 1) * 20) + 1)$$
3. Each attribute is allocated a length of 1 for the value. You will read/write the **Beginning File Offset** for a length of 1.
4. If a value is writeable, then the new value will be displayed when read next, else there was an error.
5. If the attribute is not a REAL or DINT value, then an error will appear.

Example reading Box 2 Min Temperature:

- File Number = 209
- Beginning File Offset = 8101
- Example Min Temperature is 302.25 Kelvin

F209:8101 = 302.25

Appendix B – Modbus TCP Assembly Mappings

The EtherNet/IP assemblies are also available to access using Modbus TCP.

Mapping 1 - Write Assembly Mapping

You must use Unit ID 1 to access.

This mapping gives you write access to some parameters over Modbus TCP.

Register 400XXX	Data								Data Access
1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Image Mode	Image Live	Image Freeze	Reserved	Reserved	DO 2	DO 1	
2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
4	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read/Write
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	

Mapping 2 - Read Assembly Values

You must use Unit ID 1 to access.

The Temperature values are mapped as a floating point value with the least significant word stored in the first register and the most significant word store in the second register. Registers 1001-1004 will be mapped in the same order as Mapping 3.

Example: Spot 1 temperature value of 302.25 will be mapped as follows:

Register 401019: 0x2000

Register 401020: 0x4397

Register 40XXXX	Data								Data Access
1001	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm	Image Mode	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
1002	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
1003	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
1004	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
1005-1006	Delta Temperature 1								Read Only
1007-1008	Delta Temperature 2								Read Only
1009-1010	Delta Temperature 3								Read Only

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Register 40XXXX	Data	Data Access
1011-1012	Delta Temperature 4	Read Only
1013-1014	Delta Temperature 5	Read Only
1015-1016	Delta Temperature 6	Read Only
1017-1018	Internal Camera Temperature	Read Only
1019-1020	Spot 1 Temperature	Read Only
1021-1022	Box 1 Min Temperature	Read Only
1023-1024	Box 1 Max Temperature	Read Only
1025-1026	Box 1 Average Temperature	Read Only
1027	Spot 1 Temperature Valid State	Read Only
1028	Box 1 Min Temperature Valid State	Read Only
1029	Box 1 Max Temperature Valid State	Read Only
1030	Box 1 Avg Temperature Valid State	Read Only
1031-1032	Spot 2 Temperature	Read Only
1033-1034	Box 2 Min Temperature	Read Only
1035-1036	Box 2 Max Temperature	Read Only
1037-1038	Box 2 Average Temperature	Read Only
1039	Spot 2 Temperature Valid State	Read Only
1040	Box 2 Min Temperature Valid State	Read Only
1041	Box 2 Max Temperature Valid State	Read Only
1042	Box 2 Avg Temperature Valid State	Read Only
1043-1044	Spot 3 Temperature	Read Only
1045-1046	Box 3 Min Temperature	Read Only
1047-1048	Box 3 Max Temperature	Read Only
1049-1050	Box 3 Average Temperature	Read Only
1051	Spot 3 Temperature Valid State	Read Only
1052	Box 3 Min Temperature Valid State	Read Only
1053	Box 3 Max Temperature Valid State	Read Only
1054	Box 3 Avg Temperature Valid State	Read Only

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Register 40XXXX	Data	Data Access
1055-1056	Spot 4 Temperature	Read Only
1057-1058	Box 4 Min Temperature	Read Only
1059-1060	Box 4 Max Temperature	Read Only
1061-1062	Box 4 Average Temperature	Read Only
1063	Spot 4 Temperature Valid State	Read Only
1064	Box 4 Min Temperature Valid State	Read Only
1065	Box 4 Max Temperature Valid State	Read Only
1066	Box 4 Avg Temperature Valid State	Read Only
1067-1078	.....Spot 5/ Box 5.....	Read Only
1079-1090	.....Spot 6/ Box 6.....	Read Only
1091-1102	.....Spot 7/ Box 7.....	Read Only
1103-1114	.....Spot 8/ Box 8.....	Read Only
1115-1126	.....Spot 9/ Box 9.....	Read Only
1127-1138	.....Spot 10/ Box 10.....	Read Only
1139-1150	.....Spot 11/ Box 11.....	Read Only
1151-1162	.....Spot 12/ Box 12.....	Read Only
1163-1174	.....Spot 13/ Box 13.....	Read Only
1175-1186	.....Spot 14/ Box 14.....	Read Only
1187-1198	.....Spot 15/ Box 15.....	Read Only
1199-1210	.....Spot 16/ Box 16.....	Read Only
1211-1222	.....Spot 17/ Box 17.....	Read Only
1223-1234	.....Spot 18/ Box 18.....	Read Only
1235-1246	.....Spot 19/ Box 19.....	Read Only
1247-1258	.....Spot 20/ Box 20.....	Read Only

Mapping 3 - Read Assembly Values

You must use Unit ID 1 to access.

The Temperature values are mapped as a floating point value with the most significant word stored in the first register and the least significant word store in the second register. Registers 2001-2004 will be mapped in the same order as Mapping 2.

Example: Spot 1 temperature value of 302.25 will be mapped as follows:

Register 402019: 0x4397

Register 402020: 0x2000

Register 40XXXX	Data								Data Access
2001	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Force Image One Shot	Save Image	One Time Image Auto Adjust	Auto Focus Fast	Auto Focus Full	Force NUC	Auto NUC	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Disable Alarm	Image Mode	Image Live	Image Freeze	DI 2	DI 1	DO 2	DO 1	
2002	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Atmospheric Temp. Graphic	Reflected Temp. Graphic	Distance Graphic	Emissivity Graphic	Date/Time Graphic	Scale Graphic	Camera Label Graphic	Enable Overlay Graphics	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Measurement Mark Graphic	Lens Graphic	Relative Humidity Graphic	
2003	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Alarm 8	Alarm 7	Alarm 6	Alarm 5	Alarm 4	Alarm 3	Alarm 2	Alarm 1	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Set Configuration Preset (RESERVED FOR FUTURE USE)								
2004	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Read Only
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	
2005-2006	Delta Temperature 1								Read Only
2007-2008	Delta Temperature 2								Read Only
2009-2010	Delta Temperature 3								Read Only

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Register 40XXXX	Data	Data Access
2011-2012	Delta Temperature 4	Read Only
2013-2014	Delta Temperature 5	Read Only
2015-2016	Delta Temperature 6	Read Only
2017-2018	Internal Camera Temperature	Read Only
2019-2020	Spot 1 Temperature	Read Only
2021-2022	Box 1 Min Temperature	Read Only
2023-2024	Box 1 Max Temperature	Read Only
2025-2026	Box 1 Average Temperature	Read Only
2027	Spot 1 Temperature Valid State	Read Only
2028	Box 1 Min Temperature Valid State	Read Only
2029	Box 1 Max Temperature Valid State	Read Only
2030	Box 1 Avg Temperature Valid State	Read Only
2031-2032	Spot 2 Temperature	Read Only
2033-2034	Box 2 Min Temperature	Read Only
2035-2036	Box 2 Max Temperature	Read Only
2037-2038	Box 2 Average Temperature	Read Only
2039	Spot 2 Temperature Valid State	Read Only
2040	Box 2 Min Temperature Valid State	Read Only
2041	Box 2 Max Temperature Valid State	Read Only
2042	Box 2 Avg Temperature Valid State	Read Only
2043-2044	Spot 3 Temperature	Read Only
2045-2046	Box 3 Min Temperature	Read Only
2047-2048	Box 3 Max Temperature	Read Only
2049-2050	Box 3 Average Temperature	Read Only
2051	Spot 3 Temperature Valid State	Read Only
2052	Box 3 Min Temperature Valid State	Read Only
2053	Box 3 Max Temperature Valid State	Read Only
2054	Box 3 Avg Temperature Valid State	Read Only

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Register 40XXXX	Data	Data Access
2055-2056	Spot 4 Temperature	Read Only
2057-2058	Box 4 Min Temperature	Read Only
2059-2060	Box 4 Max Temperature	Read Only
2061-2062	Box 4 Average Temperature	Read Only
2063	Spot 4 Temperature Valid State	Read Only
2064	Box 4 Min Temperature Valid State	Read Only
2065	Box 4 Max Temperature Valid State	Read Only
2066	Box 4 Avg Temperature Valid State	Read Only
2067-2078	.....Spot 5/ Box 5.....	Read Only
2079-2090	.....Spot 6/ Box 6.....	Read Only
2091-2102	.....Spot 7/ Box 7.....	Read Only
2103-2114	.....Spot 8/ Box 8.....	Read Only
2115-2126	.....Spot 9/ Box 9.....	Read Only
2127-2138	.....Spot 10/ Box 10.....	Read Only
2139-2150	.....Spot 11/ Box 11.....	Read Only
2151-2162	.....Spot 12/ Box 12.....	Read Only
2163-2174	.....Spot 13/ Box 13.....	Read Only
2175-2186	.....Spot 14/ Box 14.....	Read Only
2187-2198	.....Spot 15/ Box 15.....	Read Only
2199-2210	.....Spot 16/ Box 16.....	Read Only
2211-2222	.....Spot 17/ Box 17.....	Read Only
2223-2234	.....Spot 18/ Box 18.....	Read Only
2235-2246	.....Spot 19/ Box 19.....	Read Only
2247-2258	.....Spot 20/ Box 20.....	Read Only

Appendix C – Additional Modbus TCP Mappings

EtherNet/IP Objects 0x64 through 0x6F are also available to access using Modbus TCP.

Additional Modbus mappings

To access attributes in Objects 0x64-0x6F over Modbus TCP use the following information:

1. The Modbus Unit ID is the same as the decimal value of the EtherNet/IP Object number.
2. The starting register can be calculated using the following formula:

$$\text{Starting Register} = ((\text{Instance\#} * 4000) + ((\text{Attribute\#} - 1) * 20) + 1)$$
3. Each attribute is allocated a 20 registers for the value. You can read/write a maximum length of 20 at a time if the read or write begins from **Starting Register**.
4. The first register of the 20 register range is reserved for the length (in bytes) of the data value. If the attribute is a REAL/DINT value, the size will be 4 bytes, BOOL is 1 byte, UINT is 2 bytes, and the STRING size is the number of characters in the string.
5. If a value is writeable, then the new value will be displayed when read next, else there was an error.
6. If value is a DINT or REAL data type, then the following will happen:
 - a. Number of bytes will be in (**Starting Register**)
 - b. Value in Little-Endian format will be in (**Starting Register +1**) and (**Starting Register +2**)
 - c. Number of bytes again will be in (**Starting Register +3**)
 - d. Value in Big-Endian format will be in (**Starting Register +4**) and (**Starting Register +5**)
7. If a value is writeable and you are starting from **Starting Register**, the length field is ONLY REQUIRED when changing a STRING data type.
8. Only these Modbus Function Codes are supported for these mappings:
 - o 4 Read Holding Registers
 - o 16 Write Multiple Holding Registers
 - o 23 Read/ Write Multiple Holding Registers
9. If the data type is STRING, two characters make up a single register.
10. When you perform a write, if the starting address of the write is the size register, DO write the size in bytes of the value in the first register followed by the actual value starting at the second register. If the starting address of the write is not the size register, DO NOT write the size, just write the new attribute value.
 - o Example: Execute a write of 25 to Box 1 Height.
 - Modbus Unit ID = 109
 - Modbus Range = 4361 – 4380

If you write the full 20 registers starting at 4361, then you must send the size of the data type in bytes in the first register then the data:

16: PRESET MULTIPLE REGISTERS

Address: 4361
Length: 0020

4361:	4
4362:	25
4363:	0
4364:	0
4365:	0
4366:	0
4367:	0
4368:	0

From File
To File

Update Cancel

If you write every register but the first in the group, then there is no need to send the size in the request. You can just write the new values:

16: PRESET MULTIPLE REGISTERS

Address: 4362
Length: 0019

4362:	25
4363:	0
4364:	0
4365:	0
4366:	0
4367:	0
4368:	0
4369:	0

From File
To File

Update Cancel

Example reading Box 2 Min Temperature:

- Modbus Unit ID (Slave ID) = 109
- Starting Register = Holding Register 8101
- Example Min Temperature is 302.25 Kelvin

8101 = 4

8102 = 0x2000

8103 = 0x4397

8104 = 4

8105 = 0x4397

8106 = 0x2000