OSRD Protocol for Bosch PTZ Cameras

AutoDomes, MIC cameras, Receiver/Drivers and other Bosch PTZ cameras

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1 Introduction

This manual describes the On-site Receiver/Driver (OSRD) protocol that transfers messages over a serial connection to a pan/tilt/zoom device (for example a Bosch AutoDome or Allegiant series receiver/driver). This manual describes the message structure, command structure, and the values for the parameters that comprise the message. If you are not familiar with these protocols, you can use this manual to learn the syntax and capabilities of OSRD. It is recommended, however, that you understand API programming concepts and bit manipulation.

The electrical interface of this protocol is typically Bosch Biphase, but can other formats such as RS-232, RS-485, and RS-422 are also possible.

1.1 Controlling Bosch PTZ Cameras

The OSRD protocol utilizes *Opcodes* to determine the actual function to be executed by the camera. The original OSRD protocol dating back to the late-1980s contained seven Opcodes. With the introduction of the AutoDome series variable speed cameras in the mid-1990s, the OSRD protocol was extended to include nine new Opcodes.

Starting with VG4 Series of AutoDome cameras, an additional protocol named BiCom was added. BiCom provides equivalent functionality similar to the extended OSRD opcodes, but it also contains more powerful commands for features that will be implemented in future products. Full details on BiCom protocol is covered in separate document.

Full details on Opcodes can be found in Section 3 below.

To use BiCom commands within an OSRD message packet, the controller device can use Opcode 20 <0x14>.

The table below summarizes the control code protocols and the products that support each. Although all Opcodes are listed below, Bosch recommends using only Opcodes 5, 7, 8, & 9 for new development. Only these will be maintained in future platforms for the foreseeable future.

Protocol	**Device**								
	VG5 600 series AutoDome Cameras	VG4 series AutoDome Cameras	MIC550, MIC612 cameras	IP AutoDome 7000 and MIC7000[3]	VEZ 4000 & VEZ 5000 AutoDome Easy	VEZ series AutoDome Easy	G3 series AutoDome	LTC8016	Allegiant Receiver/ Driver
OSRD									
– Opcode 2 <0x02>	•	•	•		•	•	•	•	•
– Opcode 3 <0x03>	•	•	•				•	•	•
– Opcode 4 <0x04>	•	•	•				•	•	•
– Opcode 5 <0x05>	•	•	•	•	•	•	•	•	•
– Opcode 6 <0x06>	•	•	•				•	•	•
– Opcode 7 <0x07>	•[1]	•[1]	•	•	•	•	•[1]	•[2]	•
– Opcode 8 <0x08>	•	•	•	•	•	•	•	•	•
OSRD Extended									
– Opcode 9 <0x09>	•	•		•			•		
– Opcode 10 <0x0A>		•					•		

– Opcode 12 <0x0C>							•		
– Opcode 15 <0x0F>							•		
– Opcode 16 <0x10>							•		
– Opcode 18 <0x12>							•		
– Opcode 19 <0x13>		•					•		
BiCom within OSRD									
– Opcode 20 <0x14>	•	•							
BiCom	•	•		•					

1. The VG5, VG4, and G3 series AutoDomes do not support OSRD commands “Aux Toggle”, “Aux On Latch”, “Aux Off Latch”, and the “Cancel Latch Aux” commands.
2. The initial firmware version of LTC 8016 does not support the more recent Aux commands found in Dinion series cameras.
3. IP cameras require use of Decoder device that receives the serial protocol from Controller device, then forwards the data over the network to the PTZ camera.

For a complete list of controllers, functions, and supported Opcodes, see *Section 7 Appendix: Opcode Usage*, page 28.

1.2 Numeric Designations

The OSRD protocol specifies that numeric data represent the components of a command message packet. Most of the numeric data is represented as hexadecimal numbers, but some of the actual data values are expressed as decimal numbers. This manual uses the following conventions to distinguish between hexadecimal and decimal numbers:

– The value “25” is interpreted as a decimal value.

– The value “0x25” is interpreted as a hexadecimal value.

2 OSRD Commands

Control code data is sent in message packets. For certain functions, commands must be sent repetitively at a rate of 20 Hz to maintain a smooth operational response of the device being driven by the receiver/driver.

See *Section 6 Appendix: Hardware Configuration* for more information on hardware devices.

The general format of an OSRD command is:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x00	1	Packet Length Byte						
0x01	0	High Order Address byte (upper 7 bits of a 14-bit camera number)						
0x02	0	Low Order Address byte (lower 7 bits of a 14-bit camera number)						
0x03	0	Opcode						
0x04	0	Data Byte 1						
0x05	0	Data Byte 2						
0x0*N*	0	Data Byte *N*						
0x*N*+1	0	Checksum of all previous bytes (lower 7 bits only)						

2.1 OSRD Message Syntax

The following sections describe the attributes of the required information for each data byte position above.

2.1.1 Packet Length Byte

Each packet begins with a Length byte that specifies the number of bytes in the remainder of the packet (the Length byte itself is not included in this number). The most significant bit (MSB) of the Length byte is always set to 1. The MSB must be zero for ALL other bytes of the message packet. For the functions below, only control commands with lengths of 6 and 7 bits are used, therefore, the Length byte (with the MSB set) will be either 0x86 or 0x87.

2.1.2 High Order Address Byte/Low Order Address Byte

The message packet contains a device (VG4, G3, G2, or G1 AutoDome and Receiver/Driver) address number encoded using a 14-bit binary value. (Including an address value permits the data to be broadcast to all receiver/driver sites but only the site set to a matching address will respond.) This address number is sent using 2 bytes of the message packet. The binary value corresponds to the logical camera number of the camera site being controlled minus 1.

The High Order Address byte consists of the upper 7 bits of the 14-bit binary camera number. The Low Order Address byte consists of the lower 7 bits of the 14-bit binary camera number. In all cases, the MSB of each byte is not counted as part of the address number and must always be reset to zero so it will not be confused with the Length byte. Since the use of a 14- bit binary number provides a camera number range from 1 to 16384, the corresponding device Address data bytes would take the form of 0x0000 to 0x7F7F. The High Order Byte (the upper 7 bits of the 14-bit binary camera number) is used for cameras with an address greater than 127. Use the Low Order Byte (the lower 7 bits of the 14- bit binary camera number) for cameras with an address of 1 to 127.

For example, camera number 1 is encoded with all 14 data bits reset to zero. Camera number

2 has its Least Significant Bit (LSB) set to 1 and all other bits set to zero. The table below provides examples of Address Bytes:

Camera Number	Encoded Value	14-bit Binary Value	High Order Byte	Low Order Byte
1	0	0000000 0000000	0x00	0x00
2	1	0000000 0000001	0x00	0x01
128	127	0000000 1111111	0x00	0x7F
129	128	0000001 0000000	0x80	0x00
256	255	0000001 1111111	0x01	0x7F
257	256	0000010 0000000	0x02	0x00
500	499	0000011 1110011	0x03	0x73
512	511	0000011 1111111	0x03	0x7F
513	512	0000100 0000000	0x04	0x00
1024	1023	0000111 1111111	0x07	0x7F
5000	4999	0100111 0000111	0x27	0x07
9999	9998	1001110 0001110	0x4E	0x0E
16384	16383	1111111 1111111	0x7F	0x7F

2.1.3 Opcode

Defines the type of data packet. See *Section 3 Opcode Descriptions* for details about each Opcode. Use Opcode 20 (0x14) to send a BiCom API message to a VG4 AutoDome.

2.1.4 Data Bytes

Each Opcode requires a specific number of data byte fields. The data bytes determine the function that the controller device sends to the head-end device. Refer to the specific Opcode description below for the appropriate number of data byte fields and for the appropriate values for the fields.

2.1.5 Checksum

Calculate the sum of each 8-bit number (including the Length byte) for the entire command syntax using mod 0x7F. To calculate the checksum value, convert any binary numbers into a hexadecimal value. For example, using a scientific calculator, add each hexidecimal message packet value to arrive at the message packet subtotal. Once you have the subtotal, use the bitwise AND operator to apply 0x7F to the subtotal to arrive at the checksum value. For example, if the message packet consists of:

```
0x8B 0x00 0x00 0x14 0x00 0x60 0x01 0x01 0x02 0x00 0x01 0x04
```

To calculate the checksum, use the following formula (all values are expressed in hexadecimal):

```
(8B+00+00+14+00+60+01+01+02+00+01) AND 7F = 0x04
```

3 Opcode Descriptions

This section describes the standard and the extended set of OSRD Opcode commands. The standard set of Opcodes consists of Opcodes 2 <0x02> through 8 <0x08> (Opcode 1 <0x01> is not used) and are available for all Receiver/Drivers and G1, G2, G3 and VG4 Series AutoDomes.

The extended set consists of Opcodes 9 <0x09>, 10 <0x0A>, 12 <0x0C>, 15 <0x0F>, 16 <0x10>, 18 <0x12>, Opcode 19 <0x13>, and Opcode 20 <0x14>. The extended set is available for G3 AutoDomes, version 5.00 or higher, only.

In all cases, a 1 written into a bit position initiates the specified action. If conflicting bits are set (e.g., Pan Left and Pan Right), the action is undefined, but the device resolves the conflict with no damage. If the device receives a command while still processing a previous command, the old command is aborted, and the new one executed. To issue the corresponding command with a VG4 Series AutoDome, use Opcode 20 (0x14). See *Section 4 Opcode 20 <0x14>: BiCom Command Interface*, page 22.

3.1 Standard Opcodes

The standard Opcodes are the original OSRD Opcodes and are available for all Bosch AutoDome models and Receiver/Drivers.

Each Opcode sends a command to a device for a specified period of time, which is referenced in the title of the Opcode in the following way:

- **Start/Stop**: The command is in effect until a controller device sends a stop command.
- **Repetitive**: The device controller must send the same command within a specified period of time or the camera ceases the command function.

3.1.1 Opcode 2 <0x02>: Start/Stop Fixed-speed PTZ, Focus, and Iris

Opcode 2 <0x02> activates fixed-speed pan/tilt/zoom functions for an indefinite period. A logical 1 (one) activates the indicated function, which remains active until explicitly turned off. The functions can be turned off by a command with a different Opcode or by Opcode 2

<0x02> with a 0 (zero) in the associated data bit position.

Command	<0x86><*Address MSB*><*Address LSB*><0x02><*Data Byte 1*><*Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	X	X	Pan Left	Tilt Up	Zoom Out	Focus Near	Iris Brighter
Data Byte 2	0	X	X	Pan Right	Tilt Down	Zoom In	Focus Far	Iris Darker

- An X indicates that the bit position is not used.
- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.

3.1.2 Opcode 3 <0x03>: Fixed-speed PTZ for a Specified Period

Opcode 3 <0x03> is referred to as the "poor man's preposition" because it can be used to operate any pan/tilt/zoom device (even those without preposition capability) to approximate positions by moving for a specified time in the desired direction. The duration of the function is specified using a 6-bit data value where the time is specified in units of half-seconds. This provides a time range of 1/2 second duration (all bits reset to zero) to 32 seconds (all bits set to 1). Note that the actual duration of the function may only approximate the specified time due to conditions at the receiver/driver site.

Command	<0x86><*Address MSB*><*Address LSB*><0x03><*Data Byte 1*><*Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	Duration Bit 5	Duration Bit 4	Duration Bit 3	Duration Bit 2	Duration Bit 1	Duration Bit 0	Focus Far
Data Byte 2	0	Focus Near	Zoom In	Zoom Out	Tilt Up	Tilt Down	Pan Left	Pan Right

- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.
- The operation continues for the time specified in bits 1 through 5 or until stopped by this or another Opcode.

3.1.3 Opcode 4 <0x04>: Repetitive Fixed-speed PTZ

Opcode 4 <0x04> activates pan/tilt/zoom functions at a fixed speed determined by the Receiver/Driver or by the AutoDome. This Opcode activates the specified function for at least

50ms, so the command must be issued at a frequency of no less than 20Hz for smooth operation.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x04><*Data Byte 1*><*Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	X	X	X	1	1	1	Focus Far
Data Byte 2	0	Focus Near	Zoom In	Zoom Out	Tilt Up	Tilt Down	Pan Left	Pan Right

- An X indicates that the bit position is not used.
- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.

3.1.4 Opcode 5 <0x05>: Start/Stop Variable-speed PTZ

Opcode 5 <0x05> activates variable-speed functions for an indefinite period. A logic one activates the indicated function, which remains active until explicitly turned off. The appropriate Speed Bits determine the speed for the Pan, Tilt, and Zoom operations. The Receiver/Driver settings determine the Focus and Iris speed. The functions can be turned off by a command with a different Opcode or by Opcode 5 <0x05> with a zero in the associated data bit position.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x05><*Data Byte 1*><*Data Byte 2*><*Data Byte 3*> <checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	Zoom Speed Bit 2	Zoom Speed Bit 1	Zoom Speed Bit 0	Tilt Speed Bit 3	Tilt Speed Bit 2	Tilt Speed Bit 1	Tilt Speed Bit 0
Data Byte 2	0	Pan Speed Bit 3	Pan Speed Bit 2	Pan Speed Bit 1	Pan Speed Bit 0	Iris Brighter	Iris Darker	Focus Far
Data Byte 3	0	Focus Near	Zoom In	Zoom Out	Tilt Up	Tilt Down	Pan Left	Pan Right

- An X indicates that the bit position is not used.
- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.

3.1.5 Opcode 6 <0x06>: Repetitive Fixed-speed Zoom, Focus, and Iris

Opcode 6 <0x06> activates the zoom, focus, and iris functions at a fixed speed determined by the Receiver/Driver or by the AutoDome. This Opcode causes the specified function to be activated for at least 50 ms, so the command must be issued at a frequency of no less than 20Hz for smooth operation.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x06><*Data Byte 1*><*Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	X	X	X	X	X	X	X
Data Byte 2	0	X	Iris Brighter	Iris Darker	Focus Far	Focus Near	Zoom In	Zoom Out

- An X indicates that the bit position is not used.
- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.

3.1.6 Opcode 7 <0x07>: Auxiliary ON/OFF and Preposition SET/SHOT Commands

Opcode 7 <0x07> activates preposition or auxiliary functions. The numeric data consists of a 10-bit binary number. The upper 3 bits of this 10-bit number along with the desired function is sent as Data Byte 1. The lower 7 bits of the 10-bit number is sent as Data Byte 2. The Auxiliary On and Off commands are sometimes issued repetitively to control level adjustment functions.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x07><*Data Byte 1*><*Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	Data Bit 9	Data Bit 8	Data Bit 7	Function Code Bit 3	Function Code Bit 2	Function Code Bit 1	Function Code Bit 0
Data Byte 2	0	Data Bit 6	Data Bit 5	Data Bit 4	Data Bit 3	Data Bit 2	Data Bit 1	Data Bit 0

- Data Bits 0 through 9 specify the Auxiliary Number or the Pre-position Number, with available values from 0 through 1023.
- Function Code Bits 0 through 3 specify the type of operation as defined in the following table.

Function Code Bits 0–3	**Function**	**Data Bits 0–9**	**Description**
0000	Reserved	Undefined	Not used
0001	Auxiliary ON	Auxiliary Number	ON–*Auxiliary_Number*–ENTER
0010	Auxiliary OFF	Auxiliary Number	OFF–*Auxiliary_Number*–ENTER
0011			
0100	Pre-position SET	Pre-position Number	SET–*Pre-position_Number*–ENTER
0101	Pre-position SHOT	Pre-position Number	SHOT–*Pre-position_Number*–ENTER
0110	Reserved	Undefined	Not Used
0111	Reserved	Undefined	Not Used
1000	Cancel Latching Aux	Undefined	Latching Auxiliary ON and OFF functions are used to activate the auxiliary function until explicitly deactivated using the Cancel Latching Aux command.
1001	Latching Aux ON	Auxiliary Number	
1010	Latching Aux OFF	Auxiliary Number	
1011	Reserved	Undefined	Not Used

Function Code Bits 0–3	Function	Data Bits 0–9	Description
1100	Reserved	Undefined	Not Used
1101	Reserved	Undefined	Not Used
1110	Reserved	Undefined	Not Used
1111	Reserved	Undefined	Not Used

3.1.7 Opcode 8 <0x08>: Repetitive Variable-speed PTZ, Focus, and Iris

Opcode 8 <0x08> activates pan, tilt, zoom, focus, and iris functions. It provides for variable speed control over pan/tilt/zoom functions. The pan and tilt functions require a speed value of

0 to 15; 0 is the slowest speed and 15 is the fastest speed. The zoom function requires a speed value of 0 to 7; 0 is the slowest speed and 7 is the fastest speed. This Opcode causes the specified function to be activated for at least 50 ms, so the command must be issued at a frequency of no less than 20 Hz for smooth operation.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x08><*Data Byte 1*><*Data Byte 2*><*Data Byte 3*> <checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	Zoom Speed Bit 2	Zoom Speed Bit 1	Zoom Speed Bit 0	Tilt Speed Bit 3	Tilt Speed Bit 2	Tilt Speed Bit 1	Tilt Speed Bit 0
Data Byte 2	0	Pan Speed Bit 3	Pan Speed Bit 2	Pan Speed Bit 1	Pan Speed Bit 0	Iris Brighter	Iris Darker	Focus Far
Data Byte 3	0	Focus Near	Zoom In	Zoom Out	Tilt Up	Tilt Down	Pan Left	Pan Right

- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.
- The appropriate Speed Bits determine the speed for the pan, tilt, and zoom operations.
- The Receiver/Driver settings determine the speed for the focus and iris operations.

3.2 Extended OSRD Commands

The Extended set of OSRD commands (Opcodes 9 <0x09>, 10 <0x0A>, 12 <0x0C>, 15 <0x0F>, 16 <0x10>, 18 <0x12>, and 19 <0x13) is available only for G3 AutoDomes version 5.00 or higher.

NOTICE! An operator must use Opcode 14 <0x14> with the Bilinx Command Interface syntax to send the extended OSRD commands to a VG4 Series AutoDome (see *Section 4 Opcode 20 <0x14>: BiCom Command Interface*, page 22).

3.2.1 Opcode 9 <0x09>: Fine Speed PTZ

Opcode 9 <0x09> activates pan, tilt, zoom, focus, and iris functions. It provides for continuous fine speed control over pan/tilt/zoom functions. The allowed speed for a pan or tilt operation is from 1 degree/second to 128 degrees/second. A speed setting of 0 corresponds to 1 degree/second and a speed setting of 127 corresponds to the maximum speed of 128 degrees/second. The functions can be turned off by a command with a different Opcode or by Opcode 9 <0x09> with a zero in the associated data bit position.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x09><*Data Byte 1*><*Data Byte 2*><*Data Byte 3*> <checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Byte 1	0	Pan Speed Bit 6	Pan Speed Bit 5	Pan Speed Bit 4	Pan Speed Bit 3	Pan Speed Bit 2	Pan Speed Bit 1	Pan Speed Bit 0
Data Byte 2	0	Tilt Speed Bit 6	Tilt Speed Bit 5	Tilt Speed Bit 4	Tilt Speed Bit 3	Tilt Speed Bit 2	Tilt Speed Bit 1	Tilt Speed Bit 0
Data Byte 3	0	Zoom Speed Bit 2	Zoom Speed Bit 1	Zoom Speed Bit 0	X	Iris Brighter	Iris Darker	Focus Far
Data Byte 4	0	Focus Near	Zoom In	Zoom Out	Tilt Up	Tilt Down	Pan Left	Pan Right

- An X indicates that the bit position is not used.
- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.
- The Receiver/Driver settings determine the speed for the focus and iris operations.

3.2.2 Opcode 10 <0x0A>: Position Report and Reply (4-byte version)

Opcode 10 <0x0A> (4-byte version) queries the G3 AutoDome for its current pan and tilt positions. The value for the pan position varies from 0 (zero) to 127,999, which represents the full 360 degree rotation. The value 0 represents the Home position of the AutoDome and the values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.

The value for the tilt position varies from 0 (zero) to 31,999 to represent the 90 degree tilt range. The value 0 represents the Home position of the AutoDome and the values increase as the Tilt position of the AutoDome moves in the tilt-down direction. For example, if the tilt position of the AutoDome is at the 90 degree down angle, the value for the tilt position is 31,999.

Note: Opcode 10 <0x0A> is a variable length command. This section describes the 4-byte version of the command. See the next section for a description of the 10-, 12-, 16-, and the 17- byte versions of Opcode 10 <0x0A>.

Received Command	<0x84><*Address MSB*><*Address LSB*><0x0A><checksum>							
Reply	<*length byte w/Bit7 set*><*Address MSB*><*Address LSB*><0x87><0x0A> <*Pan Position Data Byte 1*><*Pan Position Data Byte 2*> <*Pan Position Data Byte 3*> <*Tilt Position Data Byte 1*><*Tilt Position Data Byte 2*><*Tilt Position Data Byte 3*><checksum>							
	Response Data Byte Codes							
	7	6	5	4	3	2	1	0
Pan Position Data Byte 1	0	0	0	0	0	Pan Position Bit 16	Pan Position Bit 15	Pan Position Bit 14
Pan Position Data Byte 2	0	Pan Position Bit 13	Pan Position Bit 12	Pan Position Bit 11	Pan Position Bit 10	Pan Position Bit 9	Pan Position Bit 8	Pan Position Bit 7
Pan Position Data Byte 3	0	Pan Position Bit 6	Pan Position Bit 5	Pan Position Bit 4	Pan Position Bit 3	Pan Position Bit 2	Pan Position Bit 1	Pan Position Bit 0
Tilt Position Data Byte 1	0	0	0	0	0	0	0	Tilt Position Bit 14
Tilt Position Date Byte 2	0	Tilt Position Bit 13	Tilt Position Bit 12	Tilt Position Bit 11	Tilt Position Bit 10	Tilt Position Bit 9	Tilt Position Bit 8	Tilt Position Bit 7
Tilt Position Data Byte 3	0	Tilt Position Bit 6	Tilt Position Bit 5	Tilt Position Bit 4	Tilt Position Bit 3	Tilt Position Bit 2	Tilt Position Bit 1	Tilt Position Bit 0

- A value of 1 (one) in a bit position starts the operation.
- A value of 0 (zero) in a bit position stops the operation.
- The Receiver/Driver settings determine the speed for the focus and iris operations.

3.2.3 Opcode 10 <0x0A>: Position Commands (10-, 12-, 16-, 17-byte versions)

Opcode 10 <0x0A> (the 10-, 12-, 16-, and the 17-byte version) commands the G3 AutoDome to move to an absolute position at a specified velocity and acceleration. This Opcode also commands the device to set the absolute positions for the zoom, focus, and the iris functions. The value for the pan position varies from 0 (zero) to 127,999, which represents the full 360 degree rotation. The value 0 represents the Home position of the AutoDome and the values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.

The value for the tilt position varies from 0 (zero) to 31,999 to represent the 90 degree tilt range. The value 0 represents the Home position of the AutoDome and the values increase as the Tilt position of the AutoDome moves in the tilt-down direction. For example, if the tilt position of the AutoDome is at the 90 degree down angle, the value for the tilt position is 31,999.

The acceptable values for the pan and tilt velocities and for the pan and tilt accelerations are from 0 through 7. The velocity values represent evenly spaced speeds from 10 degrees/second to 130 degrees/second, while the acceleration values represent evenly spaced acceleration from 10 degrees/second^2 to 130 degrees/second^2. The device ignores the Velocity/Acceleration values, however, if the value for the Velocity/Acceleration Ignore Bit is set to 1.

In addition to the pan and tilt settings, Opcode 10 <0x0A> allows an operator to set the values for the zoom, focus, iris, backlight compensation, AGC, and the white balance functions. The following table summarizes the values for these functions:

Function	Values	Explanation
Zoom	Range of 0x4 to 0xAA or 0xFF	OxFF instructs the unit to ignore any setting for the particular function.
Focus	Range of 0x8 to 0xFE or OxFF	
Iris	Range of 0x31 to 0xCF or 0xFF	
AutoFocus	0 (zero) or 1	0 deactivates the function. 1 activates the function.
AutoIris	0 (zero) or 1	
Backlight Compensation	0 (zero) or 1	
AGC	0 (zero) or 1	
White Balance	0x00	Sets white balance to Automatic.
	0x01	Sets white balance to Indoor.
	0x10	Sets white balance to Outdoor.
	0x11	Sets white balance to One-push.

Note: Opcode 10 <0x0A> is a variable length command. This section describes the 10-, 12-, 16-, and the 17-byte versions of the command. See the previous section for a description of the 4-byte version of Opcode 10 <0x0A>.

Received Command	**IF** 10-byte length, **ADD**: <0x8A>… **ELSE** **IF** 12-byte length **ADD**: <0x9C>… **ELSE IF** 16-byte length **ADD**: <0x90>… **ELSE IF** 17-byte length **ADD**: <0x91>… ; **THEN** **ADD** <Address MSB><Address LSB><0x0A><Pan Position Data Byte 1><Pan Position Data Byte 2><Pan Position Data Byte 3><Tilt Position Data Byte 1> <Tilt Position Data Byte 2><Tilt Position Data Byte 3>… **THEN** **IF** Length >= 12 bytes; **ADD** <PanVelocity/Acceleration Data Byte><TiltVelocity/Acceleration Data Byte>… **THEN** **IF** Length >= 16 bytes; **ADD** <Zoom/Focus/Iris Configuration and LSBs>Zoom Position Data Byte> <Focus Position Data Byte><Iris Position Data Byte>… **THEN** **IF** Length >= 17 bytes; **ADD** <Camera Setting Data Byte>… **ELSE ADD** (for all lengths) <checksum>								
	Data Byte Codes (as required by the number of bytes)							
	7	6	5	4	3	2	1	0
Pan Position Data Byte 1	0	Pan Position Ignore Bit	0	0	0	Pan Position Bit 16	Pan Position Bit 15	Pan Position Bit 14
Pan Position Data Byte 2	0	Pan Position Bit 13	Pan Position Bit 12	Pan Position Bit 11	Pan Position Bit 10	Pan Position Bit 9	Pan Position Bit 8	Pan Position Bit 7
Pan Position Data Byte 3	0	Pan Position Bit 6	Pan Position Bit 5	Pan Position Bit 4	Pan Position Bit 3	Pan Position Bit 2	Pan Position Bit 1	Pan Position Bit 0
Tilt Position Data Byte 1	0	Tilt Position Ignore Bit	0	0	0	0	0	Tilt Position Bit 14
Tilt Position Date Byte 2	0	Tilt Position Bit 13	Tilt Position Bit 12	Tilt Position Bit 11	Tilt Position Bit 10	Tilt Position Bit 9	Tilt Position Bit 8	Tilt Position Bit 7
Tilt Position Data Byte 3	0	Tilt Position Bit 6	Tilt Position Bit 5	Tilt Position Bit 4	Tilt Position Bit 3	Tilt Position Bit 2	Tilt Position Bit 1	Tilt Position Bit 0

Pan Velocity/ Acceleration Data Byte	0	Pan Velocity/ Accel. Ignore Bit	Pan Accel. Bit 2	Pan Accel. Bit 1	Pan Accel. Bit 0	Pan Velocity Bit 2	Pan Velocity Bit 1	Pan Velocity Bit 0
Tilt Velocity/ Acceleration Data Byte	0	Tilt Velocity/ Accel. Ignore Bit	Tilt Accel. Bit 2	Tilt Accel. Bit 1	Tilt Accel. Bit 0	Tilt Velocity Bit 2	Tilt Velocity Bit 1	Tilt Velocity Bit 0
Lens Mode and LSB	0	X	Auto Iris Bit	Auto Focus Bit	X	Zoom Position Bit 0	Focus Position Bit 0	Iris Position Bit 0
Zoom Position Data Byte	0	Zoom Position Bit 7	Zoom Position Bit 6	Zoom Position Bit 5	Zoom Position Bit 4	Zoom Position Bit 3	Zoom Position Bit 2	Zoom Position Bit 1
Focus Position Data Byte	0	Focus Position Bit 7	Focus Position Bit 6	Focus Position Bit 5	Focus Position Bit 4	Focus Position Bit 3	Focus Position Bit 2	Focus Position Bit 1
Iris Position Data Byte	0	Iris Position Bit 7	Iris Position Bit 6	Iris Position Bit 5	Iris Position Bit 4	Iris Position Bit 3	Iris Position Bit 2	Iris Position Bit 1
Camera Settings Data Byte	0	X	X	X	Backlight Comp. Bit	AGC Bit	White Balance Bit 1	White Balance Bit 0

3.2.4 Opcode 12 <0x0C>: Ping Command (no data requested)

Opcode 12 <0x0C> queries the G3 AutoDome to establish communications. When the device receives a query with a ping type of 0 (zero) it responds with the reply in the table below. The device returns no other data.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x0C><0x00 (ping type)><*Data Requested Data Byte*><checksum>							
Reply	<*length byte w/Bit7 set*><*Address MSB*><*Address LSB*><0x4C><0x00><0x00><0x00><0x00><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Ping Type Data Byte	0	Ping Type 0x00						
Data Requested Data Byte	0	Query Camera Settings Bit	Query Lens Mode and LSB Data Bit	Query Iris Position Bit	Query Focus Position Bit	Query Zoom Position Bit	Query Tilt Position Bit	Query Pan Position Bit

3.2.5 Opcode 12 <0x0C>: Ping Command (data requested)

Opcode 12 <0x0C>, with data requested, queries the G3 AutoDome for the values of the settings as determined in the Received Command. When the device receives a query with a ping type of 1 it responds with the reply in the table below. The data that this Opcode receives is summarized in this table:

Function	Values	Explanation
Pan Position	0 (zero) through 127,999	0 represents the Home position of the AutoDome. Values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.
Tilt Position	0 (zero) through 31,999	0 represents the Home position of the AutoDome. Values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.
Zoom	Range of 0x04 to 0xAA	
Focus	Range of 0x08 to 0xFE	
Iris	Range of 0x31 to 0xCF	
AutoFocus	0 (zero) or 1	0 indicates the function is deactivated. 1 indicates the function is activate.
AutoIris	0 (zero) or 1	
Backlight Compensation	0 (zero) or 1	
AGC	0 (zero) or 1	
White Balance	0x00	White balance is set to Automatic.
	0x01	White balance is set to Indoor.
	0x10	White balance is set to Outdoor.
	0x11	White balance is set to One-push.

Received Command	<0x86><*Address MSB*><*Address LSB*><0x0C><0x01 (ping type)> <*Data Requested Data Byte*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Ping Type Data Byte	0	Ping Type 0x01						
Data Requested Data Byte	0	Query Camera Settings Bit	Query Lens Mode and LSB Data Bit	Query Iris Position Bit	Query Focus Position Bit	Query Zoom Position Bit	Query Tilt Position Bit	Query Pan Position Bit
Reply	<*length byte w/Bit7 set*><*Address MSB*><*Address LSB*><0x4C><0x01> <*Data Requested Data Byte*><*...Requested Data...*><checksum>							
	Response Data Byte Codes							
	7	6	5	4	3	2	1	0
Pan Position Data	0	0	0	0	0	Pan Position Bit 16	Pan Position Bit 15	Pan Position Bit 14
	0	Pan Position Bit 13	Pan Position Bit 12	Pan Position Bit 11	Pan Position Bit 10	Pan Position Bit 9	Pan Position Bit 8	Pan Position Bit 7
	0	Pan Position Bit 6	Pan Position Bit 5	Pan Position Bit 4	Pan Position Bit 3	Pan Position Bit 2	Pan Position Bit 1	Pan Position Bit 0
Tilt Position Data	0	0	0	0	0	0	0	Tilt Position Bit 14
	0	Tilt Position Bit 13	Tilt Position Bit 12	Tilt Position Bit 11	Tilt Position Bit 10	Tilt Position Bit 9	Tilt Position Bit 8	Tilt Position Bit 7
	0	Tilt Position Bit 6	Tilt Position Bit 5	Tilt Position Bit 4	Tilt Position Bit 3	Tilt Position Bit 2	Tilt Position Bit 1	Tilt Position Bit 0

Lens Mode and LSB Bit Data	0	X	Auto Iris Bit	Auto Focus Bit	X	Zoom Position Bit 0	Focus Position Bit 0	Iris Position Bit 0
Zoom Position Data	0	Zoom Position Bit 7	Zoom Position Bit 6	Zoom Position Bit 5	Zoom Position Bit 4	Zoom Position Bit 3	Zoom Position Bit 2	Zoom Position Bit 1
Focus Position Data	0	Focus Position Bit 7	Focus Position Bit 6	Focus Position Bit 5	Focus Position Bit 4	Focus Position Bit 3	Focus Position Bit 2	Focus Position Bit 1
Iris Position Data	0	Iris Position Bit 7	Iris Position Bit 6	Iris Position Bit 5	Iris Position Bit 4	Iris Position Bit 3	Iris Position Bit 2	Iris Position Bit 1
Camera Settings	0	X	X	X	Backlight Comp. Bit	AGC Bit	White Balance Bit 1	White Balance Bit 0

3.2.6 Opcode 15 <0x0F>: Information Requested and Reply

Opcode 15 <0x0F> queries a G2 or G3 AutoDome to obtain information about the device. The amount and type of information returned depends on the structure of the message. The message may contain requests for specific values contained in these three categories:

- Data Requested: AutoTrack, AutoDome Information Request, Special Tracking Mode, and AutoTrack Frequency
- AutoDome Data: Receiver/Driver or Camera Type, Receiver/Driver Software Version, Line Lock Delay, Camera Settings, and E-Zoom
- Tracking Components: Camera Data, Lens Mode and LSB, Iris Position, Focus Position, Zoom Position, Tilt Position, and Pan Position.

Depending on the information requested from the query message, the device returns a message with the appropriate values for these device attributes:

Function	Returned Value	Explanation
AutoDome Generation	0x02	LTC 0809, AutoDome Generation 2
	0x03	LTC 0829, AutoDome Generation 3
Camera Type	0x42	High-resolution NTSC Color Camera
	0x43	High-resolution PAL Color Camera
Maximum Lens Zoom		Maximum amount of zoom possible for the lens.
Software Version	*whole_number.fractional number*	The whole number to the left of the decimal point is the major release number.
		The fractional number to the right of the decimal point is the version of the release.
Line Lock Delay		The delay value from the zero crossing used for the Line Lock function.
Backlight Compensation	0 (zero) or 1	0 indicates the function is deactivated.
AGC		1 indicates the function is activate.
White Balance	0x00	White balance is set to Automatic.
	0x01	White balance is set to Indoor.
	0x10	White balance is set to Outdoor.
	0x11	White balance is set to One-push.
E-Zoom		The current electronic zoom setting.

Function	Returned Value	Explanation
AutoTrack Frequency	0x00	5 Hz
	0x01	10 Hz
	0x10	20 Hz
	x011	30 Hz
Pan Position	0 (zero) through 127,999	0 represents the Home position of the AutoDome. Values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.
Tilt Position	0 (zero) through 31,999	0 represents the Home position of the AutoDome. Values increase as the Pan position of the AutoDome moves in the left-to-right direction from the Home position.
Zoom	Range of 0x04 to 0xAA	
Focus	Range of 0x08 to 0xFE	
Iris	Range of 0x31 to 0xCF	
AutoFocus	0 (zero) or 1	0 indicates the function is deactivated. 1 indicates the function is activate.
AutoIris	0 (zero) or 1	
White Balance	0x00	White balance is set to Automatic.
	0x01	White balance is set to Indoor.
	0x10	White balance is set to Outdoor.
	0x11	White balance is set to One-push.

Received Command	*<0x87><Address MSB><Address LSB>*<0x0F>*<Data Requested Data Byte><AutoDome Data Requested Data Byte><Tracking Components Data Byte>*<checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Data Requested Data Byte	0	AutoTrack Bit	AutoDome Information Request Bit	X	X	Special Tracking Mode Bit	AutoTrack Frequency Bit 1	AutoTrack Frequency Bit 2
Autodome Data Requested Data Byte	0	Receiver/ Driver and Camera Type Information Bit	Receiver/ Driver Software Version Bit	Line Lock Delay Setting Bit	Camera Settings Data Bit	E-Zoom Data Bit	X	X
Tracking Components Requested Data Byte	0	Query Camera Data Bit	Query Lens Mode and LSB Data Bit	Query Iris Position Bit	Query Focus Position Bit	Query Zoom Position Bit	Query Tilt Position Bit	Query Pan Position Bit
Reply	0	*<length byte w/Bit7 set><Address MSB><Address LSB>*<0x4F> *<Data Requested Data Byte* (with the Auto Track Bit set to 0)> *<Autodome Data Requested Data Byte>*<0x00>*<...Requested Data...>*<checksum>						
	Response Data Byte Codes							
	7	6	5	4	3	2	1	0

Receiver/ Driver and Camera Type Information	0	AutoDome Generation Number Bit 6	AutoDome Generation Number Bit 5	AutoDome Generation Number Bit 4	AutoDome Generation Number Bit	AutoDome Generation Number Bit 2	AutoDome Generation Number Bit 1	AutoDome Generation Number Bit 0
	0	Camera Type Bit 6	Camera Type Bit 5	Camera Type Bit 4	Camera Type Bit 3	Camera Type Bit 2	Camera Type Bit 1	Camera Type Bit 0
	0	Lens Max Zoom Bit 6	Lens Max Zoom Bit 5	Lens Max Zoom Bit 4	Lens Max Zoom Bit 3	Lens Max Zoom Bit 2	Lens Max Zoom Bit 1	Lens Max Zoom Bit 0
Receiver/ Driver Software Version	0	Version Whole Number Bit 6	Version Whole Number Bit 5	Version Whole Number Bit 4	Version Whole Number Bit	Version Whole Number Bit 2	Version Whole Number Bit 1	Version Whole Number Bit 0
	0	Version Fractional Number Bit 6	Version Fractional Number Bit 5	Version Fractional Number Bit 4	Version Fractional Number Bit	Version Fractional Number Bit 2	Version Fractional Number Bit 1	Version Fractional Number Bit 0
Line Lock Delay Setting	0	Line Lock Delay Bit 13	Line Lock Delay Bit 12	Line Lock Delay Bit 11	Line Lock Delay Bit	Line Lock Delay Bit 9	Line Lock Delay Bit 8	Line Lock Delay Bit 7
	0	Line Lock Delay Bit 6	Line Lock Delay Bit 5	Line Lock Delay Bit 4	Line Lock Delay Bit 3	Line Lock Delay Bit 2	Line Lock Delay Bit 1	Line Lock Delay Bit 0
Camera Settings Data	0	X	X	X	Backlight Comp. Bit	AGC Bit	White Balance Bit 1	White Balance Bit 0
E-Zoom Data	0	E-Zoom Data Bit 6	E-Zoom Data Bit 5	E-Zoom Data Bit 4	E-Zoom Data Bit 3	E-Zoom Data Bit 2	E-Zoom Data Bit 1	E-Zoom Data Bit 0
Automatic Position Reply	*<length byte w/Bit7 set><Address MSB><Address LSB>*<0x4F><0x40><0x00> *<Tracking Components Data Byte><...Requested Data...>*<checksum>							
	Response Data Byte Codes							
	7	6	5	4	3	2	1	0
Pan Position Data	0	0	0	0	0	Pan Position Bit 16	Pan Position Bit 15	Pan Position Bit 14
	0	Pan Position Bit 13	Pan Position Bit 12	Pan Position Bit 11	Pan Position Bit 10	Pan Position Bit 9	Pan Position Bit 8	Pan Position Bit 7
	0	Pan Position Bit 6	Pan Position Bit 5	Pan Position Bit 4	Pan Position Bit 3	Pan Position Bit 2	Pan Position Bit 1	Pan Position Bit 0
Tilt Position Data	0	0	0	0	0	0	0	Tilt Position Bit 14
	0	Tilt Position Bit 13	Tilt Position Bit 12	Tilt Position Bit 11	Tilt Position Bit 10	Tilt Position Bit 9	Tilt Position Bit 8	Tilt Position Bit 7
	0	Tilt Position Bit 6	Tilt Position Bit 5	Tilt Position Bit 4	Tilt Position Bit 3	Tilt Position Bit 2	Tilt Position Bit 1	Tilt Position Bit 0
Lens Mode and LSB Bit Data	0	X	Auto Iris Bit	Auto Focus Bit	X	Zoom Position Bit 0	Focus Position Bit 0	Iris Position Bit 0
Zoom Position Data	0	Zoom Position Bit 7	Zoom Position Bit 6	Zoom Position Bit 5	Zoom Position Bit 4	Zoom Position Bit 3	Zoom Position Bit 2	Zoom Position Bit 1
Focus Position Data	0	Focus Position Bit 7	Focus Position Bit 6	Focus Position Bit 5	Focus Position Bit 4	Focus Position Bit 3	Focus Position Bit 2	Focus Position Bit 1
Iris Position Data	0	Iris Position Bit 7	Iris Position Bit 6	Iris Position Bit 5	Iris Position Bit 4	Iris Position Bit 3	Iris Position Bit 2	Iris Position Bit 1
Camera Settings	0	X	X	X	Backlight Comp. Bit	AGC Bit	White Balance Bit 1	White Balance Bit 0

3.2.7 Opcode 16 <0x10>: Title Set

Opcode 16 <0x10> sends shot and zone titles to the camera device. Keep these conditions in mind when issuing this command:

- The value of the Length byte is 0x85 + the number of characters in the title.
- You must include leading spaces with a title. Trailing spaces, however, are not necessary.
- The Opcode command overwrites previous titles.
- The Opcode sends a maximum of 16 characters in the ASCII format.

To specify the Title Number for the shot or the zone, use:

- Shots 1 through 99: use the values 1 through 99, respectively.
- Zones 1 through 16: use the values 100 through 116, respectively.

The syntax for the Opcode 16 <0x10> command is:

<0x8X><*Address MSB*><*Address LSB*><0x10><*TitleNumber*><*Char1*>...<*Char16*><checksum>

3.2.8 Opcode 18 <0x12>: Auxiliary Commands with Data

Opcode 18 <0x12> directly adjusts and requests user-specified parameters, including parameters that accept actual values, not just On/Off commands. The following table lists the auxiliary commands and their associated values:

Auxiliary Code	Command Name	Pre-encoded Data	Full Range Data
3	Iris Control	0 = Auto 1 = Manual	N/A
4	Focus Control	0 = Spot 1 = Continuous Auto 2 = Continuous Manual	
9	Return On	0 = Off 1 = Preset 1 2 = Previous Aux	
11	AutoIris Level Adjustment	Step 1 to 15	
14	AutoPan Speed		1 to 60 degrees/second
15	Pre-position Tour Period	Index into a zero-based array of seconds (3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60, 120, 180, 240, 300, 600) for example, 2 = 5 seconds and 4 = 15 seconds	
18	AutoPivot	0 = Off 1 = On	
20	Backlight Compensation	0 = Off 1 = On	

Auxiliary Code	Command Name	Pre-encoded Data	Full Range Data
23	Electronic Shutter	X = NTSC - PAL 0 = Auto Slow Shutter 1 = 1 2 = 1/2 3 = 1/4 to 1/3 4 = 1/8 to 1/6 5 = 1/15 to 1/12 6 = 1/30 to 1/25 7 = 1/60 to 1/60 8 = 1/90 to 1/75 9 = 1/100 to 1/100 10 = 1/125 to 1/120 11 = 1/180 to 1/150 12 = 1/250 to 1/215 13 = 1/350 to 1/300 14 = 1/500 to 1/425 15 = 1/100 to 1/1000 16 = 1/1500 to 1/1250 17 = 1/2000 to 1/1750 18 = 1/3000 to 1/2500 19 = 1/4000 to 1/3500 20 = 1/6000 to 1/6000 21 = 1/10000 to 1/10000	
24	Electronic Stabilization (25X camera only)	0 = Off 1 = On	
30	White Balance	0 = Auto 1 = Indoor 2 = Outdoor 3 = One Push 4 = Extended Auto	
41	Line Lock Phase Adjust		0 to 359 degrees
42	Sync Mode	0 = Line Lock 1 = Crystal	
43	AGC	Maximum Gain Setting: 6 = 28 db 5 = 24 db 4 = 20 db 3 = 16 db 2 = 12 db 1 = 8 db	
44	Aperture Correction	Step 1 to 16	
56	Night Mode	0 = Off 1 = On 2 = Auto	

Auxiliary Code	Command Name	Pre-encoded Data	Full Range Data
58	IRE	Steps 1 through 10: 1 = 10 IRE 2 = 15 IRE 3 = 20 IRE 4 = 25 IRE 5 = 30 IRE 6 = 35 IRE 7 = 40 IRE 8 = 45 IRE 9 = 60 IRE 10 = 55 IRE	
60	On-screen Display	0 = Off 1 = On	
61	On-screen Display Adjust		Data [7:0]: Line Number 0 to max Data [15:8] = Brightness
65	Alarm/Relay State	bit [3:0] (Get only): Alarm input 3-1 state 1 = Active 2 = Not bit [4] (Set/Get): Relay Output 1 = Active 0 = Not	
66	Display Software Version (Get only)		Major.Minor Data [15:8] = Major value Data [7:0] = Minor value
80	Digital Zoom	0 = Disable 1 = Enable	
86	Sector Masking	Data [15:0] = sectors 1 through 16	
91	Zoom Polarity	0 = Normal 1 = Reversed	
92	Focus Polarity	0 = Normal 1 = Reversed	
93	Iris Polarity	0 = Normal 1 = Reversed	
201	PTZ Fixed-speed Control Speed	Steps 1 through 15	
202	Focus Speed	Steps 1 through 8	
203	Iris Speed	Steps 1 through 10	
204	Inactivity Period	Index into a zero-based array of seconds (3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60, 120, 180, 240, 300, 600) for example, 2 = 5 seconds and 4 = 15 seconds	
205	Max Zoom Speed	0 = Slowest 1 = Medium 2 = Fastest	

Auxiliary Code	Command Name	Pre-encoded Data	Full Range Data
206	Unique Identifier		Unique identifier that is burnt in the program flash that is currently used for FastAddressing
207	Password		Actual password in BCD format
208	Boot Code Revision (Get only)		Major.Minor Data [15:8] = Major value Data [7:0] = Minor value
209	Alarm Setup Information	Bit: [1:0]: Alarm input -1 [3:2]: 00=Off, 01=N.O., 10=N.C., 11=Pressure [10:4]: Got to shot, 0=not shot [11] OSD: 1=yes, 0=no [12] Transmit: 1=yes, 0=no [13] Track: 1=yes, 0=no	

3.2.9 Opcode 19 <0x13>: Set/Get Position

Opcode 19 <0x13> sets or gets the pan, tilt, and zoom positions in radians (radians x 1000) and focal length (mm x 10). For example, if the current pan position is 1.234 radians, the device returns the value 1234; and if the focal length is 5.6 mm, the device returns the value 56.

Received Command	<0x8B><*Address MSB*><*Address LSB*><0x13><*Pan Position Data Byte 1*><*Pan Position Data Byte 2*><*Tilt Position Data Byte 1*><*Tilt Position Data Byte 2*><*Focal Length Data Byte 1*><*Focal Length Data Byte 2*><checksum>							
Reply	<0x8B><*Address MSB*><*Address LSB*><0x13><*Pan Position Data Byte 1*><*Pan Position Data Byte 2*><*Tilt Position Data Byte 1*><*Tilt Position Data Byte 2*><*Focal Length Data Byte 1*><*Focal Length Data Byte 2*><checksum>							
	Data Byte Codes							
	7	6	5	4	3	2	1	0
Ignore Data	0	0	0	0	0	Ignore Zoom	Ignore Tilt	Ignore Pan
Pan Position Data	0	Ignore Pan Position	Pan Position Bit 12	Pan Position Bit 11	Pan Position Bit 10	Pan Position Bit 9	Pan Position Bit 8	Pan Position Bit 7
	0	Pan Position Bit 6	Pan Position Bit 5	Pan Position Bit 4	Pan Position Bit 3	Pan Position Bit 2	Pan Position Bit 1	Pan Position Bit 0
Tilt Position Data	0	Ignore Tilt Position	Tilt Position Bit 12	Tilt Position Bit 11	Tilt Position Bit 10	Tilt Position Bit 9	Tilt Position Bit 8	Tilt Position Bit 7
	0	Tilt Position Bit 6	Tilt Position Bit 5	Tilt Position Bit 4	Tilt Position Bit 3	Tilt Position Bit 2	Tilt Position Bit 1	Tilt Position Bit 0
Focal Length Data Byte	0	Focal Length Bit 13	Focal Length Bit 12	Focal Length Bit 11	Focal Length Bit 10	Focal Length Bit 9	Focal Length Bit 8	Focal Length Bit 7
	0	Focal Length Bit 6	Focal Length Bit 5	Focal Length Bit 4	Focal Length Bit 3	Focal Length Bit 2	Focal Length Bit 1	Focal Length Bit 0

4 Opcode 20 <0x14>: BiCom Command Interface

This chapter describes the syntax and structure of a BiCom command sent within an OSRD message packet using Opcode 20 <0x14>. This Opcode allows a controller device to send a BiCom command to a camera that supports only the Standard Opcodes.

This chapter describes the three aspects of the BiCom protocol:

- The syntax for sending a BiCom command within an OSRD message packet.
- The method to identify the command that sends an instruction to or receives a value from a VG4 Series AutoDome.
- The location of each bit in the command message.

NOTICE! You must use a BiCom command within an OSRD message packet (using Opcode 20 <0x14> to send or an Extended Opcode command to a VG4 Series AutoDome.

See the *BiCom Protocol for Bosch PTZ Cameras* manual for a full description of the BiCom protocol.

4.1 Data Byte Codes

Each component of the command syntax after the <0x14> constant consists of a value in each bit location for a byte or a two-byte number.

		Data Bit Position							
		7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Length		value = 1	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Address	MSB	value = 0	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
	LSB	value = 0	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Server ID	MSB	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
	LSB	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Opcode 14		value = 0	value = 0	value = 0	value = 1	value = 0	value = 1	value = 0	value = 0
Object/	MSB	Object Bit 12	Object Bit 11	Object Bit 10	Object Bit 9	Object Bit 8	Object Bit 7	Object Bit 6	Object Bit 5
Member ID	LSB	Object Bit 4	Object Bit 3	Object Bit 2	Object Bit 1	Member Bit 3	Member Bit 2	Member Bit 1	Member Bit 0
Operation		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data Byte 1		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data Byte *N*		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(15 max)									
Checksum		value=0	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

4.2 BiCom Byte Descriptions

The following sections describe the bytes required by the BiCom protocol to send a command. See the *BiCom Protocol for Bosch PTZ Cameras* manual for a full description of the BiCom protocol.

4.2.1 Server ID

The Server ID parameter consists of two bytes. Once the eight positions of the LSB are filled, use the next 8 positions in the MSB.

Server Name	Server ID MSB	Server ID LSB
Device Server	0x00	0x020
I/O Server	0x00	0x0A0
Content Analysis (CA) Server	0x00	0x080
Camera Server	0x00	0x040
PTZ Server	0x00	0x060

4.2.2 Object/Member ID

The Object/Member ID bytes consist of two bytes, but the division of the MSB and the LSB differ from that of the Server ID. Using the object/member pair allows you to group settings in one object. For example, the object Position contains the members Orientation and Area (among others). The Member ID consists of the first four bit positions of the LSB (0, 1, 2, 3) and the Object ID consists of bit position 4 through 7 of the LSB and all eight bit positions of the MSB. For example, the following two-byte string contains the ID for the **Position** object and the ID for the **Orientation** member:

Object ID								**Member ID**							
MSB								**LSB**							
0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	
Position Object								**Orientation Member**							

This two-byte string translates to 0x011A in hexidecimal.

4.2.3 Operation

Identifies the Operation to be performed on the object/member. The Generic Operations Type table, below, describes the operations in the range 0x00–0x7F that are common to all object/members (not all operations are available on all object/members). See the *BiCom Protocol for Bosch PTZ Cameras* manual for a full description of the Generic operations. Every object can also define its own unique operations, which reside in the range 0x80–0xFF.

Operation	Code	Description
Get	0x01	Returns the object value.
Set	0x02	Sets the object value.
SetGet	0x03	Sets the object value and returns it.
Inc	0x04	Increments the object value with a predefined value.
IncGet	0x05	Increments the object value with a predefined value and returns it.
Dec	0x06	Decrements the object value with a predefined value.
DecGet	0x07	Decrements the object value with a predefined value and returns it.
SetDefault	0x08	Resets the object value to the default value.
SetGetDefault	0x09	Resets the object value to the default value and returns the new value.
Nop	0x0A	No function. The operation is used to check if an object exists.
GetMax	0x0B	Returns the maximum value of the object.
GetMin	0x0C	Returns the minimum value of the object.
Reserved	0x0D–0x06E	
Error	0x6F	Error
Event	0x70–0x7F	Returns a value on an event (not requested).

4.2.4 Data Bytes

Each BiCom requires a specific number of data byte fields. See the *BiCom Protocol for Bosch PTZ Cameras* manual for a full description of the data bytes required for each BiCom command.

5 Examples

This section presents two real-world examples of sending commands to a VG4 AutoDome using Opcode 14.

To communicate with the VG4 AutoDome, the operator uses the following syntax:

<length_with_bit_7_set><Address_MSB><Address_LSB><0x14>*<Server_ID_MSB> <Server_ID_LSB><Object/Member_ID_MSB><Object/Member_ID_LSB><Operation><Data_Byte_1>…<Data_Byte_n>*<checksum>

5.1 Setting the AutoPanScan Speed

To set the AutoPanScan speed of Fast Address camera 8 to 30°/seconds, the operator issues the following command to the camera:

Syntax	length_with_bit_7_set	Address_MSB	Address_LSB	Opcode 0x14	Server_ID_MSB	Server_ID_LSB	Object/ID	Member_ID	Operation	Data_Byte_1	Data_Byte_2	checksum
Value	**<0x8B>**	**<0x00>**	**<0x07>**	**<0x14>**	**<0x00>**	**<0x60>**	**<0x01>**	**<0x02>**	**<0x02>**	**<0x00>**	**<0x1E>**	**<0x29>**
Description	length	camera number 8		constant	VG4 PTZ server		AutoPanScan	Speed	Set	30°/second		

This command does not return a value to the operator

5.2 Inverting the Camera Image

To set the **Position/Orientation** (Object/Member) to invert the image for Fast Address camera 8 and to get the setting for the **Position/Orientation** issue the following command:

Syntax	length_with_bit_7_set	Address_MSB	Address_LSB	Opcode 0x14	Server_ID_MSB	Server_ID_LSB	Object/ID	Member_ID	Operation	Data_Byte_1	Data_Byte_2	checksum
Value	**<0x8B>**	**<0x00>**	**<0x07>**	**<0x14>**	**<0x00>**	**<0x60>**	**<0x01>**	**<0x1A>**	**<0x03>**	**<0x00>**	**<0x01>**	**<0x25>**
Description	length	camera number 8		constant	VG4 PTZ server		Position	Orientation	SetGet	Value **1** = Invert		

The operator sends the command above to set the **Orientation** to invert the camera image. The VG4, then, returns the command below that confirms that the camera accepted the setting.

Syntax	length_with_bit_7_set	Address_MSB	Address_LSB	Opcode	Server_ID_MSB	Server_ID_LSB	Object/ID	Member_ID	Operation	Data_Byte_1	Data_Byte_2	checksum

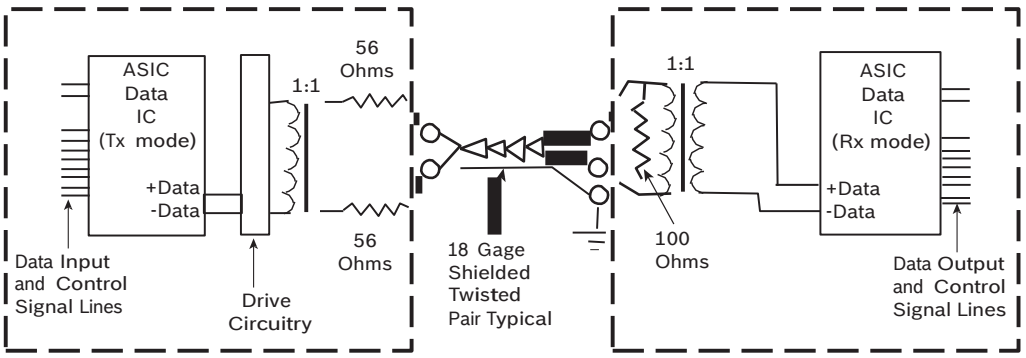
Value	**<0x8B>**	**<0x00>**	**<0x07>**	**<0x54>**	**<0x00>**	**<0x60>**	**<0x01>**	**<0x1A>**	**<0x03>**	**<0x00>**	**<0x01>**	**<0x65>**
Description	length	camera	number 8	constant	VG4 PTZ server		Position	Orientation	SetGet	Value **1** = Invert		

The return command mirrors the send command except for the Opcode constant value, which in turn changes the value for checksum. In this case, the camera confirms that the image is inverted because the Data Byte packets are the same as in the send command.

6 Appendix: Hardware Configuration

Bosch Security System Allegiant series hardware based controller products employ a high speed serial data line to communicate with remote PTZ cameras and/or Allegiant series LTC 8560 and LTC 8561 Receiver/Drivers. This data communication scheme has the following characteristics:

- Default RS-232 parameters for receiver/drivers are:
  9600 baud, 1 stop bit, 8 data bits, no parity, and no handshake.
- The data communication scheme uses an Application Specific Integrated Circuit (ASIC) transceiver design.
- The ASIC chip handles the signal processing and sends the data in a "message packet" format.
- If the data consists of a single command (such as those associated with preposition or auxiliary control commands), only a single message packet may be transmitted. If the data sent is continuous (such as those associated with an Allegiant keyboard PTZ operation), the packets are repeated at the rate of 20 times per second.
- The message packet duration depends upon the type of data being sent and may vary from approximately 2.8 milliseconds (i.e., a single preposition command) to over 28 milliseconds (i.e., Allegiant "Crosspoint" data).
- The transmission circuit utilizes a transformer coupled design having 120 ohm characteristic line impedance.
- When no data is sent, the transmission line is completely non-active -- no carrier signal or other voltage is present.
- The overall amplitude can vary significantly (it is a differential type signal), but typically it ranges between 1 and 3 volts peak-to-peak.
- A concept of the data transmission link is shown in the following diagram:



7 Appendix: Opcode Usage

This table summarizes the Opcode used for a specific function sent from a specific controller:

	Opcode Usage Based on Function Below				
Controllers (Note: Some in list are obsolete)	**P/T**	**Zoom**	**Focus**	**Iris**	**Aux PP**
Allegiant					
– GUI (variable speed icon device)	5	5	2	2	7
– GUI (fixed speed icon device)	2	2	2	2	7
– Variable Speed KBD (UF22=Var; CPU 7 on)	8	8	8	8	7
– Variable Speed KBD (UF22=Fix; CPU 7 on)	4	4	4	6	7
– Fixed Speed KBD (UF22=Var; CPU 7 off)	4	6	6	6	7
– Fixed Speed KBD (UF22=Var; CPU 7 off)	4	6	6	6	7
– Allegiant Sequence Functions	3	3	3	N/A	7
BVMS					
– GUI Mode	TBD	TBD	TBD	TBD	TBD
– IntuiKey Keyboard	TBD	TBD	TBD	TBD	TBD
DESA XL/DESA 8	8	8	8	6	7
Divar					
– IntuiKey Keyboard	8	8	8	8	7
– Control Center Software	8	8	8	8	7
– Web Server	5	5	5	5	7
DiBos 8 (v. 8.0.1)					
– GUI Mode	5	5	5	5	7
– Web Browser	5	5	5	5	N/A
LTC 5136 AutoDome Controller	8	8	8	8	7
LTC 5138 Virtual Keyboard (discontinued)	5	5	2	2	7
VIDOS Software					
– GUI Mode	5	5	2	2	7
– IntuiKey Keyboard	5	5	2	2	7
VIPX Encoder COM Port, v. 2.0.0 (Web browser)	5	5	5	5	7
VJ Encoder COM Port, V. 2.11 (Web browser)	5	5	N/A	5	7
VIP Encoder COM Port, v. 2.10 (Web browser)	5	5	N/A	5	7

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