



GNAT 1080p 60™ 1080p 60 fps HD-SDI Camera

Protocol and Registers

Version 1.0.0



October 9, 2014

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☐ Revision History

Version		Contents	Writer	Date
1.0.0		1. To describe the protocol and registers	Nick	2014-07-04

1. Introduction

1.1. Purpose

This document describes our customized protocol and control registers for the GNAT 1080p 60. Users can control the GNAT individually via 485 communication. The GNAT supports PELCO-D, P. But PELCO-D, P controls only OSD direction keys. This document explains how to use other functions and control registers.

2. Protocol

Our protocol has two types.

2.1. Protocol 1

There is no CAMERA ID. This protocol is general and can be used for any versions of firmware.

The format is:

	Header						Address				Data		Tail
ASCII	#	I	S	P	W	=	E	2	0	0	0	4	
Hex	23	49	53	50	57	3D	45	32	30	30	30	34	0D

- The above example is for the white balance mode selection.
- The address is 0xE200. The data is 0x04. The white balance is set to Manual Mode.

2.2. Protocol 2

This protocol has the CAMERA ID. Several cameras can be controlled individually.

The format is:

	Header							Camera ID		Address				Data		Tail
ASCII	#	I	S	P	W	2	=	0	1	E	2	0	0	0	4	
Hex	23	49	53	50	57	32	3D	30	31	45	32	30	30	30	34	0D

The available firmware versions are:

Camera Model	Version
GNAT 1080p 60	GNAT_D_Merge_v1.8.7.8
	GNAT_O_Merge_v1.9.7.9
	GNAT_J_Merge_v1.7.7.8
GNAT 1080p 60 S	GNAT_D_Merge_v1.3.2.2
	GNAT_O_Merge_v1.4.2.3
	GNAT_J_Merge_v1.2.2.2

 D: 60i/60p, O: 59.94i/60p, J: 59.94i/59.94p

The above versions have only the Camera ID of the protocol. Other versions don't support this protocol 2.

2.3. Caution (Protocol)

When controlling the registers, only bits of the register table should be changed.

If other bits of data are changed, a malfunction will probably occur.

- (Example 1) WB_MODE: Address (0xE200), Bits (2:0)

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

The other bits (bit7 ~ bit3) don't have to be changed.

If setting AWB (0x5), the data is as follows:

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	1	0	1

🔗 Data: 0x05

- (Example 2) Lens Mode: Address (0xE0F0), Bits (1:0)

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

The other bits (bit7 ~ bit2) don't have to be changed.

If setting 0x2: MANUAL Lens Mode, the data is as follows:

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	1	0	0	0	1	0

🔗 Data: 0x22

3. Registers

3.1. WB (White Balance)

Address	Name	Bits	Default Value (1 Byte)	Description
0xE200	WB_MODE	2:0	0x00	0x0: ATW 0x1: AWC 0x2: INDOOR 0x3: OUTDOOR 0x4: MANUAL 0x5: AWB
0xE201	MANUAL_BLUE_GAIN	7:0	0x32	Range: 0x00 ~ 0x64
0xE202	MANUAL_RED_GAIN	7:0	0x32	Range: 0x00 ~ 0x64
0xE21F	AWC_SET	0	0x00	1: AWC SET

3.2. HUE

Address	Name	Bits	Default Value (1 Byte)	Description
0x03E3	C_HUE_GAIN_R	7:0	0x80	Range: 0x00 ~ 0xFF
0x03E5	C_HUE_GAIN_G	7:0	0x80	Range: 0x00 ~ 0xFF
0x03E7	C_HUE_GAIN_B	7:0	0x80	Range: 0x00 ~ 0xFF

3.3. Exposure & Factory Reset

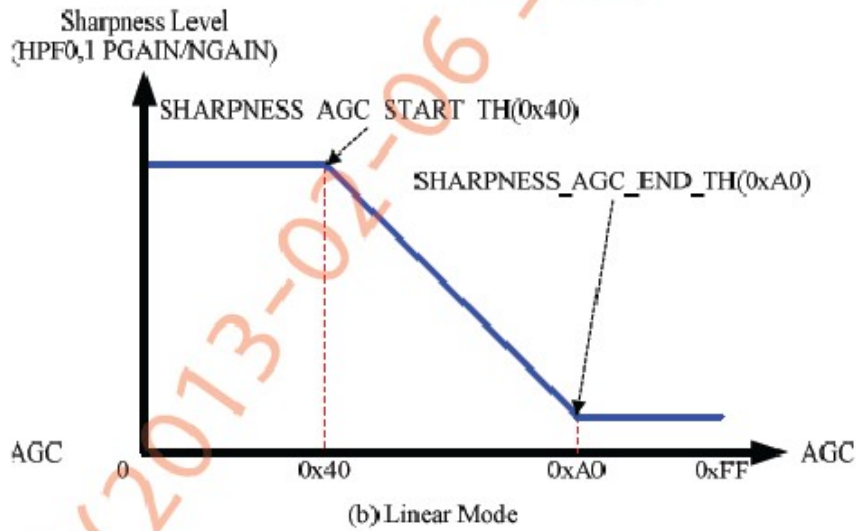
Address	Name	Bits	Default Value (1 Byte)	Description																																																																		
0xE0F1	DC_LENS_MODE	0	0x02	0x0: Indoor 0x1: Outdoor																																																																		
0xE108	DC_INDOOR_SHUT_MODE	4:0	0x00	Shutter value when "LENS_MODE" is 0x0 (DC) and "DC_LENS_MODE" is 0x0 (Indoor) <table><tr><td>Frame</td><td>30p</td><td>60p</td></tr><tr><td>Output</td><td colspan="2">NTSC (PAL)</td></tr><tr><td>0x0</td><td>Auto</td><td>Auto</td></tr><tr><td>0x1</td><td>1/30(25)</td><td>1/60(50)</td></tr><tr><td>0x2</td><td>1/60(50)</td><td>1/100(120) (FLK)</td></tr><tr><td>0x3</td><td>1/100(120) (FLK)</td><td>1/240(200)</td></tr><tr><td>0x4</td><td>1/240(200)</td><td>1/480(400)</td></tr><tr><td>0x5</td><td>1/480(400)</td><td>1/1000</td></tr><tr><td>0x6</td><td>1/1000</td><td>1/2000</td></tr><tr><td>0x7</td><td>1/2000</td><td>1/5000</td></tr><tr><td>0x8</td><td>1/5000</td><td>1/10000</td></tr><tr><td>0x9</td><td>1/10000</td><td>1/50000</td></tr><tr><td>0xA</td><td>1/50000</td><td>x2</td></tr><tr><td>0xB</td><td>x2</td><td>x4</td></tr><tr><td>0xC</td><td>x4</td><td>x6</td></tr><tr><td>0xD</td><td>x6</td><td>x8</td></tr><tr><td>0xE</td><td>x8</td><td>x10</td></tr><tr><td>0xF</td><td>x10</td><td>x15</td></tr><tr><td>0x10</td><td>x15</td><td>x20</td></tr><tr><td>0x11</td><td>x20</td><td>x25</td></tr><tr><td>0x12</td><td>x25</td><td>x30</td></tr><tr><td>0x13</td><td>x30</td><td>-</td></tr></table>	Frame	30p	60p	Output	NTSC (PAL)		0x0	Auto	Auto	0x1	1/30(25)	1/60(50)	0x2	1/60(50)	1/100(120) (FLK)	0x3	1/100(120) (FLK)	1/240(200)	0x4	1/240(200)	1/480(400)	0x5	1/480(400)	1/1000	0x6	1/1000	1/2000	0x7	1/2000	1/5000	0x8	1/5000	1/10000	0x9	1/10000	1/50000	0xA	1/50000	x2	0xB	x2	x4	0xC	x4	x6	0xD	x6	x8	0xE	x8	x10	0xF	x10	x15	0x10	x15	x20	0x11	x20	x25	0x12	x25	x30	0x13	x30	-
Frame	30p	60p																																																																				
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0x4	1/240(200)	1/480(400)																																																																				
0x5	1/480(400)	1/1000																																																																				
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0x9	1/10000	1/50000																																																																				
0xA	1/50000	x2																																																																				
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0xE	x8	x10																																																																				
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0x10	x15	x20																																																																				
0x11	x20	x25																																																																				
0x12	x25	x30																																																																				
0x13	x30	-																																																																				
0xE109	DC_OUTDOOR_SHUT_MODE	4:0	0x00	Shutter Value when "LENS_MODE" is 0x0 (DC) and "DC_LENS_MODE" is 0x1 (Outdoor)																																																																		

				Refer to the above table.
0xE0F4	MANUAL_SHUT_MODE	3:0	0x00	Shutter Value when "LENS_MODE" is 0x2 (Manual) Refer to the above table.
0xE116	Factory Reset	0	0x00	0x01: Factory Reset.

3.4. Sharpness

HPF 0/1 is available in order to increase sharpness of an image.

HPF0 uses a 3x3 filter, which is used in high frequency area and HPF1 uses a 5x5 filter, which is used in relatively low frequency area.



The linear mode (the above figure) emphasizes the edge by the sharpness level.

If Sharpness_AGC_START_TH > AGC (the gain value of auto gain controller) and the sharpness level decreases gradually until Sharpness_AGC_START_TH ≤ AGC as AGC value rises in case Sharpness_AGC_START_TH ≤ AGC.

If Sharpness_AGC_START_TH < AGC, a low light filter is applied as it is recognized as a low luminance condition.

In case Sharpness_AGC_START_TH ≥ AGC, a high light filter is applied as it is recognized as a normal luminance condition.

Address	Name	Bit	Default (1 Byte)	Description
0xE177	Sharpness_Level	3:0	0x08	
0xE178	Sharpness_AGC_START_TH	7:0	0x80	
0xE17F	Sharpness_AGC_END_TH	7:0	0xFF	
0xE179	Sharpness Filter0 PGain	7:0	0x08	
0xE17A	Sharpness Filter0 NGain	7:0	0x10	
0xE17B	Sharpness Filter1 PGain	7:0	0x08	

0xE17C	Sharpness Filter1 NGain	7:0	0x10	
0xE17D	Sharpness Filter0 P Step	7:0	0x04	
0xE17E	Sharpness Filter0 N Step	7:0	0x08	

- $\text{HPF0 Positive Gain} = \text{SHARPNESS_FILTER0_PGAIN} + (\text{SHARPNESS_LEVEL} * \text{SHARPNESS_FILTER_P_STEP})$
- $\text{HPF0 Negative Gain} = \text{SHARPNESS_FILTER0_NGAIN} + (\text{SHARPNESS_LEVEL} * \text{SHARPNESS_FILTER_N_STEP})$
- $\text{HPF1 Positive Gain} = \text{SHARPNESS_FILTER1_PGAIN} + (\text{SHARPNESS_LEVEL} * \text{SHARPNESS_FILTER_P_STEP})$
- $\text{HPF1 Negative Gain} = \text{SHARPNESS_FILTER1_NGAIN} + (\text{SHARPNESS_LEVEL} * \text{SHARPNESS_FILTER_N_STEP})$

3.5. Black Level

Address	Name	Bit	Default (1 Byte)	Description
0x0233	BLC_GR_SIGN	3	0x00	GR, R, B, GB offset sign for Bayer pattern 0: minus, 1: plus
	BLC_R_SIGN	2		
	BLC_B_SIGN	1		
	BLC_GB_SIGN	0		
0xE215	BLC_GR_OFFSET[11:8]	3:0	0x01	GR offset value
0xE216	BLC_GR_OFFSET[7:0]	7:0	0x00	30p Output Mode Range: 0 ~ 4095 ($2^{12} - 1$) Default: 0x0100
0xE217	BLC_R_OFFSET[11:8]	3:0	0x01	R offset value
0xE218	BLC_R_OFFSET[7:0]	7:0	0x00	30p Output Mode
0xE219	BLC_B_OFFSET[11:8]	3:0	0x01	B offset value
0xE21A	BLC_B_OFFSET[7:0]	7:0	0x00	30p Output Mode
0xE21B	BLC_GB_OFFSET[11:8]	3:0	0x01	GB offset value
0xE21C	BLC_GB_OFFSET[7:0]	7:0	0x00	30p Output Mode
0xE1E1	WDR_BLC_GR_OFFSET[11:8]	3:0	0x00	GR offset value
0xE1E2	WDR_BLC_GR_OFFSET[7:0]	7:0	0xF8	WDR mode or output mode other than 30p Default: 0x00F8
0xE1E3	WDR_BLC_R_OFFSET[11:8]	3:0	0x00	R offset value
0xE1E4	WDR_BLC_R_OFFSET[7:0]	7:0	0xF8	WDR mode or output mode other than 30p
0xE1E5	WDR_BLC_B_OFFSET[11:8]	3:0	0x00	B offset value
0xE1E6	WDR_BLC_B_OFFSET[7:0]	7:0	0xF8	WDR mode or output mode other than 30p
0xE1E7	WDR_BLC_GB_OFFSET[11:8]	3:0	0x00	GB offset value
0xE1EB	WDR_BLC_GB_OFFSET[7:0]	7:0	0xF8	WDR mode or output mode other than 30p

- The offset value of channels (GR, R, B, GB) can be changed separately, so the black level can be set precisely.
- For example, the default value of BLC_GR_OFFSET is 0x0100 because of using two registers BLC_GR_OFFSET[11:8] and BLC_GR_OFFSET[7:0]

3.6. Color Test Pattern

Address	Name	Bit	Default (1 Byte)	Description
0x0140	ITP_EN	7	0x20	Test Pattern Enable 0: by-pass, 1: insert test-pattern
	ITP_SEL_PATTERN	4:0		0: Color bar (H), 1: Color bar (V), 2: Color Plane (H), 3: Color Plane (V), 4: B/W Line Bar (H), 5: B/W Line Bar (V), 6: Outline 7: White Plane, 8: Yellow plane, 9: Cyan plane, 10: Green plane, 11: Magenta plane, 12: Red plane, 13: Blue plane, 14: Black plane, 15: User Color 16: Hatch 17: Y Ramp (H) 18: Y Ramp (V) 19: R Ramp (H) 20: R Ramp (V) 21: G Ramp (H) 22: G Ramp (V) 23: B Ramp (H) 24: B Ramp (V)
0x0141	ITP_COLOR_FULL	0	0x20	All level 0: 75%, 1:100%
	ITP_SEL_SWAP_V	5		Bayer Data vertical swap
	ITP_SEL_SWAP_H	4		Bayer Data horizontal swap

Memory Map (0x0140)

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ITP_EN	0	1	ITP_SEL_PATTERN				

Memory Map (0x0141)

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	ITP_SEL_SWAP_V	ITP_SEL_SWAP_H	0	0	0	ITP_COLOR_FULL

If setting registers as following, the general test pattern will appear. The pattern is seven color bars.

1. Address (0x0140), Data (0xA0)
2. Address (0x0141), Data (0x01)

3.7. AGC Limit & Brightness

Address	Name	Bit	Default (1 Byte)	Description
0xE0F2	AGC_MODE	3:0	0x0F	AGC Limit 0x0: AGC Off 0x1: AGC 17 Limit (2.8 db) 0x2: AGC 34 Limit (5.6 db) 0x3: AGC 51 Limit (8.4 db) 0x4: AGC 68 Limit (11.2db) 0x5: AGC 85 Limit (14 db) 0x6: AGC 102 Limit (16.8db) 0x7: AGC 119 Limit (19.6db) 0x8: AGC 136 Limit (22.4db) 0x9: AGC 153 Limit (25.2db) 0xA: AGC 170 Limit (28 db) 0xB: AGC 187 Limit (30.8db) 0xC: AGC 204 Limit (33.6db) 0xD: AGC 221 Limit (36.4db) 0xE: AGC 238 Limit (39.2db) 0xF: AGC 255 Limit (42 db)
0xE0F6	BRIGHTNESS	6:0	0xA8	Range: 0x0 ~ 0x64

3.8. Mirror Mode

Address	Name	Bit	Default (1 Byte)	Description
0xE04F	Mirror_MODE	1:0	0x00	Mirror Mode 0x0: Off (Normal Image) 0x1: Mirror 0x2: V-Flip 0x3: 180 degrees Rotate

3.9. Freeze Mode

Address	Name	Bit	Default (1 Byte)	Description
0xE04D	Freeze_MODE	0	0x00	0x0: Off 0x1: On

- If the camera is set to freeze/play in the trigger mode, it can't be operated.

3.10. OSD Key Control



- Enter: 0x23('#') + 0x4F('O') + 0x4B('K') + 0x43('C') + 0x3D('=') + 0x30 + 0x30 + 0x0D
- Left: 0x23('#') + 0x4F('O') + 0x4B('K') + 0x43('C') + 0x3D('=') + 0x30 + 0x33 + 0x0D
- Up: 0x23('#') + 0x4F('O') + 0x4B('K') + 0x43('C') + 0x3D('=') + 0x30 + 0x31 + 0x0D
- Right: 0x23('#') + 0x4F('O') + 0x4B('K') + 0x43('C') + 0x3D('=') + 0x30 + 0x34 + 0x0D
- Down: 0x23('#') + 0x4F('O') + 0x4B('K') + 0x43('C') + 0x3D('=') + 0x30 + 0x32 + 0x0D

3.11. RS485 CAMID NUM

Address	Name	Bit	Default (1 Byte)	Description
0xE1A1	RS485_CAMID_NUM	7:0	0x01	RS485 Cam ID Number Range: 0x00 ~ 0xFF

3.12. OUTPUT Frame Rate

Address: 0xE3D9

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	1	0	0	0	0	1

Address	Name	Bit	Default (1 Byte)	Description
0xE3D9	OUTPUT_FRAMERATE	7:5	0x61	0x0: 60p or 50p (Sensor 60 fps fix) 0x1: 30p or 25p (Sensor 60 fps fix) 0x2: 60i or 50i (Sensor 60 fps fix) 0x3: 30p or 25p (Sensor 30 fps fix) A: Sensor 60 fps B: Sensor 30 fps

3.13. CVBS Out Type (NTSC/PAL)

Address: 0xE0D0

Data (1 byte)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	1	0	1

Address	Name	Bit	Default (1 Byte)	Description
0xE0D0	CVBS_OUT_TYPE	0	0x05	0x0: PAL 0x1: NTSC