See the possibilities

Communication Protocol *(for ASCII command)*

WA-1000D-CL

SWIR
InGaAs Line Scan Camera

Document Version: 1.0

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Communication Protocol for WA-1000D-CL

All configuration of the camera is done via the RS-232C port. The camera can be set up from a PC running terminal emulator software.
Below is the description of the ASCII based short command protocol.

1. Communication setting

Baud Rate	9600
Data Length	8bit
Start Bit	1bit
Stop Bit	1bit
Parity	Non
Xon/Xoff Control	Non

2. Protocol

1. **Transmit the setting command to camera:**

NN is any kind of the commands.
NN=[Param.]<CR><LF>
e.g.
Send to camera: TR=0 <CR><LF>
Camera response: COMPLETE<CR><LF>

When camera receive the valid command, camera will return 'COMPLETE'.
If camera receive the command, camera will return following:
e.g.
Send to camera: TRX=0 <CR><LF>
Camera response: 01 Unknown Command!!<CR><LF>
e.g.
Send to camera: TR=99 <CR><LF>
Camera response: 02 Bad Parameters!!<CR><LF>

2. **Transmit the request command to camera:**

The status of camera's settings can be queried by transmitting NN?<CR><LF>, where NN is any kind of the commands.
The camera will return the current setting data.
e.g.
Send to camera: TR? <CR><LF>
Camera response: TR=3<CR><LF>

3. Switching baud rate between PC and camera

Camera always starts up with 9600bps. This can be switched to higher baud rates after a communication has been established. When switching to other baud rate the procedure is as follows.

e.g. Change baud rate to 115200bps

1. Confirm baud rates camera supported
   Send to camera: SBDRT? <CR><LF>
   Camera response: SBDRT=31(0x1F)<CR><LF>

2. Request new baud rate
   Send to camera: CBDRT=16(0x10) <CR><LF>
   Camera response: COMPLETE<CR><LF>

   (Change baud rate to 115200bps)

3. Rewrite new baud rate again with new baud rate (Confirmation command)
   Send to camera: CBDRT=16(0x10) <CR><LF>
   Camera response: COMPLETE<CR><LF>

   In case the camera does not receive the confirming command with new baud rate within 250ms after sending the acknowledge it falls back to the original baud rate (9600bps).

3. Command List

	Command Name	Format	Parameter	Remarks
A - General settings and useful commands.				
1	Echo Back	EB=[Param.]<CR><LF> EB?<CR><LF>	0=Echo off, 1=Echo on	Off at power up
2	Camera Status Request	ST?<CR><LF>		Actual setting
3	Online Help Request	HP?<CR><LF>		Command list
4	Firmware Program Version Request	VN?<CR><LF>		3 digits (e.g) 100 = Version 0.1.0.0
5	FPGA Program Version Request	PV?<CR><LF>		3 digits (e.g) 100 = Version 0.1.0.0
6	FPGA Program Version Request (FrontEnd)	PVFE?<CR><LF>		3 digits (e.g) 100 = Version 0.1.0.0
7	Camera ID Request	ID?<CR><LF>		max 10 characters
8	Model Name Request	MD?<CR><LF>		max 15 characters
9	User ID	UD=[Param.]<CR><LF> UD?<CR><LF>		User can save and load free text.(16 or less characters)
10	Camera Reset	CRS00=[Param.]<CR><LF>	Only 1 is allowed	
11	Supported Baudrate	SBDRT?<CR><LF>	0x10=115200 0x08=57600 0x04=38400 0x02=19200 0x01=9600	This camera supports 9600bps, 19200bps, 38400bps, 57600bps, and 115200bps.
12	Current Baudrate	CBDRT=[Param.]<CR><LF> CBDRT?<CR><LF>	0x10=115200 0x08=57600 0x04=38400 0x02=19200 0x01=9600	In case of WRITE execution (change baud rate), it needs to control in the proper sequence between Host and Camera. (Refer to the section 3.3)
B - Trigger mode				
1	TG SYNC Mode	TGSM=[Param.]<CR><LF> TGSM?<CR><LF>	0=Sync Mode 1=Async Mode	Sensor1 & Sensor2
2	Trigger Mode	TR=[Param.]<CR><LF> TR?<CR><LF>	0=No-shutter 1=Shutter select 2=Pulse width control	Sensor1
3	Trigger Mode 2	TR2=[Param.]<CR><LF> TR2?<CR><LF>	0=No-shutter 1=Shutter select 2=Pulse width control	Sensor2

4	Trigger Origin	TG=[Param.]<CR><LF> TG?<CR><LF>	0=Internal 1=External	Sensor1 TG=0 is available when TR=0 or TR=1
5	Trigger Origin 2	TG2=[Param.]<CR><LF> TG2?<CR><LF>	0=Internal 1=External	Sensor2 TG2=0 is available when TR2=0 or TR2=1
6	Trigger Input	TI=[Param.]<CR><LF> TI?<CR><LF>	0=Camera-Link 1=Hirose12pin	Sensor1
7	Trigger Input 2	TI2=[Param.]<CR><LF> TI2?<CR><LF>	0=Camera-Link 1=Hirose12pin	Sensor2
8	Trigger Polarity	TP=[Param.]<CR><LF> TP?<CR><LF>	0=Active-Low 1=Active-High	Sensor1
9	Trigger Polarity 2	TP2=[Param.]<CR><LF> TP2?<CR><LF>	0=Active-Low 1=Active-High	Sensor2
C - Line Rate, Exposure				
1	Line Rate	LR=[Param.]<CR><LF> LR?<CR><LF>	Full resolution 170 to 13340 clocks (1 clock is 149.9ns)	Sensor1
2	Line Rate 2	LR2=[Param.]<CR><LF> LR2?<CR><LF>	Full resolution 170 to 13340 clocks (1 clock is 149.9ns)	Sensor2
3	One-push auto line rate set	AR=[Param.]<CR><LF>	0=Activate one-push auto line rate set	Sensor1 Available when TG=0
4	One-push auto line rate set 2	AR”=[Param.]<CR><LF>	0=Activate one-push auto line rate set	Sensor2 Available when TG2=0
5	Auto line rate reference level	AL=[Param.]<CR><LF> AL?<CR><LF>	0 to 1023	Sensor1 At 10Bit
6	Auto line rate reference level 2	AL2=[Param.]<CR><LF> AL2?<CR><LF>	0 to 1023	Sensor2 At 10Bit
7	Programmable Exposure	PE=[Param.]<CR><LF> PE?<CR><LF>	Full resolution 136 to 13306 clocks (1 clock is 149.9ns)	Sensor1 Available when TR=1
8	Programmable Exposure 2	PE2=[Param.]<CR><LF> PE2?<CR><LF>	Full resolution 136 to 13306 clocks (1 clock is 149.9ns)	Sensor2 Available when TR2=1
9	Auto Channel Balance Shutter	AH=[Param.]<CR><LF>	0=Activate Auto Channel Balance Shutter	Sensor2
D - Image format				
1	Bit allocation	BA=[Param.]<CR><LF> BA?<CR><LF>	0=8bit, 1=10bit, 2=12bit	
2	Camera Link Type	CLT=[Param.]<CR><LF> CLT?<CR><LF>	0=2Channel 1=DualBase	CLT=0 is available when TGSM=0
3	Test Pattern	TS=[Param.]<CR><LF> TS?<CR><LF>	0=Off 1=Gray Pattern 1 2=Gray Pattern 2	Sensor1 Off at power up

			3=White	
4	Test Pattern 2	TS2=[Param.]<CR><LF> TS2?<CR><LF>	0=Off 1=Gray Pattern 1 2=Gray Pattern 2 3=White	Sensor2 Off at power up
5	Select Cable	SCB=[Param.]<CR><LF> SCB?<CR><LF>	0=Short 1=Middle 2=Long	Sensor1 & Sensor2
E - Gain and signal settings				
1	Gain mode	GM=[Param.]<CR><LF> GM?<CR><LF>	0=Master Tracking 1=Individual	Sensor1 & Sensor2
2	Gain Level	GA1T1=[Param.]<CR><LF> GA1T1?<CR><LF>	Master Tracking Mode 0 to 308 Individual 0 to 308	Sesnor1
3	Gain Level 2	GA2T1=[Param.]<CR><LF> GA1T1?<CR><LF>	Master Tracking Mode -84 to 84 Individual 0 to 308	Sensor2
4	Black Setup	BL1S=[Param.]<CR><LF> BL1S?<CR><LF>	-256 to 255	Sensor1
5	Black Setup 2	BL2S=[Param.]<CR><LF> BL2S?<CR><LF>	-256 to 255	Sensor2
6	Aberration Control	MAV=[Param.]<CR><LF> MAV?<CR><LF>	0=Off 1=On	Sensor2
7	Aberration Select	MAVCG=[Param1]<CR><LF> MAVCG?<CR><LF>	0=User1 Lens 1=User2 Lens 2=User3 Lens	Sensor2 Available when MAV=1
8	Aberration Data	CAB2=[Param.]<CR><LF> CAB2?<CR><LF>	-32768 to 32767	Sensor2 All the coefficients can be written in by writing in consecutive 112 times.
9	Aberration Input Name 1	CABN1=[Param.]<CR><LF> CABN1?<CR><LF>	User1 Lens Data Name e.g. BV28mmLens	Sensor2 Lens Data Name is 16 characters.
10	Aberration Input Name 2	CABN2=[Param.]<CR><LF> CABN2?<CR><LF>	User2 Lens Data Name e.g. BV28mmLens	Sensor2 Lens Data Name is 16 characters.
11	Aberration Input Name 3	CABN3=[Param.]<CR><LF> CABN3?<CR><LF>	User3 Lens Data Name e.g. BV28mmLens	Sensor2 Lens Data Name is 16 characters.
12	Aberration Left Side Pixel 2	CABL2=[Param1],[Param2] <CR><LF> CABL2?[Param1]<CR><LF>	Param1:User No. 0 to 2 Param2:-3,-2,-1,1,2,3	Sensor2 Param1 : MAVCG set value
13	Aberration Area No. 2	CABA2=[Param1],[Param2] <CR><LF> CABA2?[Param1]<CR><LF>	Param1:User No. 0 to 2 Param2:1 to 8	Sensor2 Param1 : MAVCG set value

14	Aberration 2nd Pixel 2	CABS2=[Param1],[Param2]<CR><LF> CABS2?[Param1]<CR><LF>	Param1:User No. 0 to 2 Param2:1 to 7	Sensor2 Param1 : MAVCG set value
15	Aberration 3rd Pixel 2	CABT2=[Param1],[Param2]<CR><LF> CABT2?[Param1]<CR><LF>	Param1:User No. 0 to 2 Param2:1 to 6	Sensor2 Param1 : MAVCG set value
16	Auto Channel Balance Gain	CB=[Param.]<CR><LF>	0=Activate Auto Channel Balance Gain	Sensor2
17	Noise reduction	NR [Param.]<CR><LF> NR?<CR><LF>	0=off 1=on	Sensor1 Default setting:0
18	Noise reduction2	NR2 [Param.]<CR><LF> NR2?<CR><LF>	0=off 1=on	Sensor2 Default setting:0
F - Shading correction, pixel gain and pixel black correction				
1	Select shading correction mode	SDC=[Param.]<CR><LF> SDC?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor1
2	Select shading correction mode 2	SDC2=[Param.]<CR><LF> SDC2?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor2
3	Run shading correction, store to user area	SDR=[Param.]<CR><LF>	Only 0 is allowed	Sensor1 Store in user setting.
4	Run shading Correction 2, store to user area	SDR2=[Param.]<CR><LF>	0=Run flat shading correction 1=Run flat shading correction (Sync Sensor1 level)	Sensor2 Store in user setting.
5	Inquire the status After shading correction	SDS?<CR><LF>	0=Shading correction has not been finished yet. 1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	Sensor1
6	Inquire the status After shading Correction 2	SDS2?<CR><LF>	0=Shading correction has not been finished yet. 1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	Sensor2

7	Select pixel gain correction mode	PGC=[Param.]<CR><LF> PGC?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor1
8	Select pixel gain correction mode 2	PGC2=[Param.]<CR><LF> PGC2?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor2
9	Run pixel gain correction, store to user area	PGR=[Param.]<CR><LF>	Only 0 is allowed	Sensor1 Store in user setting.
10	Run pixel gain Correction 2, store to user area	PGR2=[Param.]<CR><LF>	Only 0 is allowed	Sensor2 Store in user setting.
11	Inquire the status after pixel gain correction	PGS?<CR><LF>	0=Pixel gain correction has not been finished yet. 1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	Sensor1
12	Inquire the status after pixel gain correction 2	PGS2?<CR><LF>	0=Pixel gain correction has not been finished yet. 1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	Sensor2
13	Select pixel black correction mode	PBC=[Param.]<CR><LF> PBC?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor1
14	Select pixel black correction mode 2	PBC2=[Param.]<CR><LF> PBC2?<CR><LF>	0=Off (Bypass) 1=Factory area 2=User area	Sensor2
15	Run pixel black correction, store to user area	PBR=[Param.]<CR><LF>	Only 0 is allowed	Sensor1 Store in user setting.
16	Run pixel black Correction 2, store to user area	PBR2=[Param.]<CR><LF>	Only 0 is allowed	Sensor2 Store in user setting.
17	Inquire the status after pixel black correction	PBS?<CR><LF>	0=Pixel black correction has not been finished yet.	Sensor1

			1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	
18	Inquire the status after pixel black correction 2	PBS?<CR><LF>	0=Pixel black correction has not been finished yet. 1=Succeeded. 2=Error1 –image was too bright. 3=Error2 –image was too dark. 4=Error3 –Timeout occurred.	Sensor2
19	Pixel Black Data	PBD=[Param.]<CR><LF> PBD?<CR><LF>	-16383 to 16383	Sensor1 Read or Write in 1024 Times continuously. (line size 1024)
20	Pixel Black Data 2	PBD2=[Param.]<CR><LF> PBD2?<CR><LF>	-16383 to 16383	Sensor2 Read or Write in 1024 Times continuously. (line size 1024)
21	Pixel Black Data Save	PBDS=[Param.]<CR><LF>	Only 0 is allowed	Sensor1
22	Pixel Black Data 2 Save	PBDS2=[Param.]<CR><LF>	Only 0 is allowed	Sensor2
23	Pixel Gain Data	PGD=[Param.]<CR><LF> PGD?<CR><LF>	0 to 65535	Sensor1 Read or Write in 1024 Times continuously. (line size 1024)
24	Pixel Gain Data 2	PGD2=[Param.]<CR><LF> PGD2?<CR><LF>	0 to 65535	Sensor2 Read or Write in 1024 Times continuously. (line size 1024)
25	Pixel Gain Data Save	PGDS=[Param.]<CR><LF>	Only 0 is allowed	Sensor1
26	Pixel Gain Data 2 Save	PGDS2=[Param.]<CR><LF>	Only 0 is allowed	Sensor2
27	Shading Data	SDD=[Param.]<CR><LF> SDD?<CR><LF>	0 to 65535	Sensor1 Read or Write in 1024 Times continuously. (line size 1024)
28	Shading Data 2	SDD2=[Param.]<CR><LF> SDD2?<CR><LF>	0 to 65535	Sensor2 Read or Write in 1024

				Times continuously. (line size 1024)
29	Shading Data Save	SDDS=[Param.]<CR><LF>	Only 0 is allowed	Sensor1
30	Shading Data 2 Save	SDDS2=[Param.]<CR><LF>	Only 0 is allowed	Sensor2
31	Blemish Correct	BLMC=[Param.]<CR><LF> BLMC?<CR><LF>	0=Off 1=On	Sensor1
32	Blemish Correct 2	BLMC2=[Param.]<CR><LF> BLMC2?<CR><LF>	0=Off 1=On	Sensor2
33	Blemish Threshold	BLMT=[Param.]<CR><LF> BLMT?<CR><LF>	0 to 100	Sensor1
34	Blemish Threshold 2	BLMT2=[Param.]<CR><LF> BLMT2?<CR><LF>	0 to 100	Sensor2
35	Blemish Detect	BLMD=[Param.]<CR><LF>	0	Sensor1
36	Blemish Detect 2	BLMD2=[Param.]<CR><LF>	0	Sensor2
37	Blemish Position Index	BLMI=[Param.]<CR><LF> BLMI?<CR><LF>	1 to 8	Sensor1
38	Blemish Position Index 2	BLMI2=[Param.]<CR><LF> BLMI2?<CR><LF>	1 to 8	Sensor2
39	Blemish Position Data	BLMP=[Param.]<CR><LF> BLMP?<CR><LF>	1 to 1022, 1024 (1024 is disable data)	Sensor1
40	Blemish Position Data 2	BLMP2=[Param.]<CR><LF> BLMP2?<CR><LF>	1 to 1022, 1024 (1024 is disable data)	Sensor2
41	Sensor Cfa Out	SCFA=[Param.]<CR><LF> SCFA?<CR><LF>	0=Off 1=On	Sensor1
42	Sensor Cfa Out 2	SCFA2=[Param.]<CR><LF> SCFA2?<CR><LF>	0=Off 1=On	Sensor2
43	Sensor Cfb Out	SCFB=[Param.]<CR><LF> SCFB?<CR><LF>	0=Off 1=On	Sensor1
44	Sensor Cfb Out 2	SCFB2=[Param.]<CR><LF> SCFB2?<CR><LF>	0=Off 1=On	Sensor2
45	Sensor Cfc Out	SCFC=[Param.]<CR><LF> SCFC?<CR><LF>	0=Off 1=On	Sensor1
46	Sensor Cfc Out 2	SCFC2=[Param.]<CR><LF> SCFC2?<CR><LF>	0=Off 1=On	Sensor2
47	CL Cable Setting Short	SCBF0=[Param.]<CR><LF> SCBF0?<CR><LF>	0 to 255	
48	CL Cable Setting Middle	SCBF1=[Param.]<CR><LF> SCBF1?<CR><LF>	0 to 255	
49	CL Cable Setting Long	SCBF2=[Param.]<CR><LF> SCBF2?<CR><LF>	0 to 255	
50	Analog Base Gain	ABG1=[Param.]<CR><LF> ABG1?<CR><LF>	0 to 3	Sensor1 Default setting:2
51	Analog Base Gain 2	ABG2=[Param.]<CR><LF> ABG2?<CR><LF>	0 to 3	Sensor2 Default setting:2
G - LUT Control				
1	LUT Control	LUTC1=[Param.]<CR><LF>	0=Off	Sensor1

		LUTC1?<CR><LF>	1=Gamma 2=LUT	
2	LUT Control 2	LUTC2=[Param.]<CR><LF> LUTC2?<CR><LF>	0=Off 1=Gamma 2=LUT	Sensor2
3	LUT Data	LUTD1=[Param.0] [Param.1]‥[Param.255] <CR><LF> LUTD1?<CR><LF>	0 to 4095	Sensor1
4	LUT Data 2	LUTD2=[Param.0] [Param.1]‥[Param.255] <CR><LF> LUTD2?<CR><LF>	0 to 4095	Sensor2
5	Gamma	GMA1=[Param.]<CR><LF> GMA1?<CR><LF>	0 to 8	Sensor1
6	Gamma 2	GMA2=[Param.]<CR><LF> GMA2?<CR><LF>	0 to 8	Sensor2
H – Saving and loading data in EEPROM				
1	Load Setttings (from Camera EEPROM)	LD=[Param.]<CR><LF>	0=Factory area 1=User area1 2=User area2	Latest used DATA AREA will become default at next power up.
2	Save Settings (to Camera EEPROM)	SA=[Param.]<CR><LF>	1=User area1 2=User area2 Note the parameter 0 is not allowed.	
3	EEPROM Current Area No. Request.	EA?<CR><LF>	0=Factory area 1=User area1 2=User area2	The camera returns latest used DATA AREA.

4. Revision history

Revision	Date	Changes
00	2016/7/5	New release