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URG Series

Communication Protocol Specification

SYMBOL	CORRECTED REASON			PAGES	DATE	CORRECTOR	NO
APPROVED BY	CHECKED BY	DRAWN BY	DESIGNED BY	TITLE	COMMUNICATION PROTOCOL SPECIFICATION - URG SERIES		
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◆ Communication Specification ◆

RS-232C

Baud Rate	: 19.2Kbps,57.6Kbps,115.2Kbps
Parity	: None
Data Bit	: 8
Stop Bit	: 1
Flow Control	: None

USB

Version	: 2.0
Communication Speed	: Max. 12Mbps [Active 9Mbps]
Device Class	: Communication Device Class
Caution	: Access to the device from the application should be done only when the host-device configuration is complete and host recognizes the device. Port should be opened only after the OS assigns it to the device.

◆ Communication Format ◆

(HOST→SENSOR)

Command	Parameter	LF (0aH) or CR (0dH)

(SENSOR→HOST)

Command	Parameter	LF	Status	LF	Data	LF	LF

- Communication is initiated from the host side.
- There are no initiation codes. Termination code is either Line Feed (0aH) or Carriage Return (0dH).
- Command and the parameters will echo back with the status and data attached to it.
- The block check code does not have any type.
- Status other than '0' (30H) is the error code.
- The LF separates data after every 64 bytes if the data size exceeds 64 bytes.
- Two LF appear continuously at the end of the received data.

◆ Command Types ◆

【V-Command (Version Information)】

(HOST→SENSOR)

'V' (56H)	LF (0aH) or CR (0dH)

(SENSOR→HOST)

'V' (56H)	LF	
Status	LF	
Vender Information	LF	
Product Information	LF	
Firmware Version	LF	
Protocol Version	LF	
Sensor Serial Number	LF	LF

Example:
V[LF]
0[LF]
VEND:Hokuyo AUTOMATIC Co., LTD.[LF]
PROD:2D Emulator,(10Hz,1.80deg/step,0-270deg,20-4000mm)[LF]
FIRM:00003,(PBS 1.1.2Rb2),(2004/05/13)[LF]
PROT:00001,(SCIP 1.0)[LF]
SERI:0000000001[LF][LF]

【L-Command (Laser Illumination Control)】

(HOST→SENSOR)

'L' (4cH)	Control Code (1 Byte)	LF (0aH) or CR (0dH)

(SENSOR→HOST)

'L' (4cH)	Control Code (1 Byte)	LF	Status	LF	LF

Laser is switched on when the control code is '0'. It will be switched off when the code is '1'. Control codes other than these return errors.

By default, whenever the sensor is switched on laser illuminates automatically even if it was switched off before.

【S-Command (Communication Settings Change)】

(HOST→SENSOR)

'S' (53H)	Baud Rate (6 Digits)	Reserved Area (7 Digits)	LF (0aH) or CR (0dH)

(SENSOR→HOST)

'S' (53H)	Baud Rate (6 Digits)	Reserved Area (7 Digits)	Status	LF	LF

Default communication speed is set to 19.2 kbps. It can be changed to 57.6, 115.2, 250, 500 and 750 kbps by varying the settings.

Changes in the baud rate can be done only when the host gets the acceptance status '0'.

When the USB connection is used the command is accepted but it will not have any influence on the baud rate. Data in the reserved area are echoed without being reflected inside.

【G-Command (Distance Data Acquisition)】

The maximum measurable distance of the sensor is 4095 mm with 1mm resolution. Each data are expressed with 12 bits (0~4095 range). In order to reduce the data volume, 6-bit binary code is converted to 1-byte character codes. The encoding process is very simple where, the 12 bit data is separated into 6 bit each and 30H added to them.

Example:
1234mm = 010011010010_2
↓ separation
(010011_2,010010_2) = (13H, 12H)
↓ Add 30H
(43H, 42H) = (C, D)

Decoding process is the inverse of encoding where, 30H is subtracted from the data and merged using the big-endian system.

(HOST→SENSOR)

'G' (47H)	Starting Point (3 Digits)	End Point (3 Digits)	Cluster Count (2 Digits)
LF (0aH) or CR (0dH)			

When the data is less than 64 bytes:

(SENSOR→HOST)

'G' (47H)	Starting Point (3 Digits)	End Point (3 Digits)	Cluster Count (2 Digits)	LF
Status	LF			
Data	LF	LF		

When the data is exactly 65 bytes (Full N Block):

(SENSOR→HOST)

'G' (47H)	Starting Point (3 Digits)	End Point (3 Digits)	Cluster Count (2 Digits)	LF
Status	LF			
Data Block 1 (64 Byte)	LF			
・・・・・・・・・・	LF			
Data Block N (64 Byte)	LF	LF		

When the data is more than 65 bytes (Full N Block with excess of n bytes):

(SENSOR→HOST)

'G' (47H)	Starting Point (3 Digits)	End Point (3 Digits)	Cluster Count (2 Digits)	LF
Status	LF			
Data Block 1	LF			
・・・・・・・・・・	LF			
Data Block N-1 (64 Byte)	LF			
Data Block N (n Byte)	LF	LF		

To obtain the data, assign the starting point, end point and cluster count. Sensor groups the multiple neighboring points assigned by the cluster count. The minimum value from each group is supplied as distance data to the host.

Starting Point (0~768): Point of the area from where the data reading starts.
Example: "000" (30H, 30H, 30H).
End Point (0~768): Point of the area where the data reading stops.
Example: "768" (37H, 36H, 38H).
Cluster Count (0~99): Number of neighboring points that are grouped as a cluster.
Example: "01" (30H, 31H).

Angular detection range of the sensor is 270 degree (240 degree for URG-X002). Angular resolution per step is 360 degree/1024 = 0.3515625 degree.
Step numbers “0”, “384” and ‘768” implies -135 degree, 0 degree and +135 degree respectively taking the front of the sensor as a reference point (Figure below).

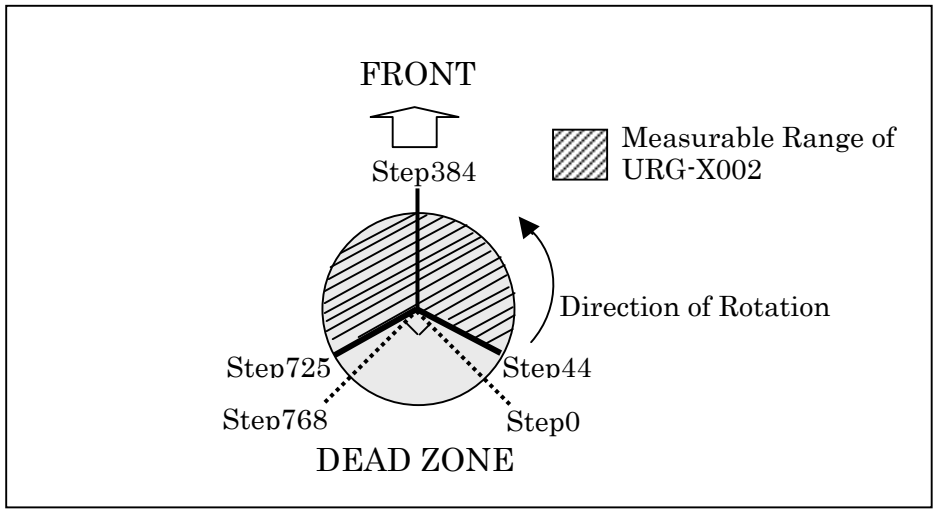

Figure: Top View

Sensor measures the distance in the range 20 mm to 4094 mm. Data less than 20mm are error codes.

Error Code	Error Type
0	Possibility of detected object is at 22m
1	Reflected light has low intensity
2	Reflected light has low intensity
3	Reflected light has low intensity
4	Reflected light has low intensity
5	Reflected light has low intensity
6	Possibility of detected object is at 5.7m
7	Distance data on the preceding and succeeding steps have errors
8	Others
9	The same step had error in the last two scan
10	Others
11	Others
12	Others
13	Others
14	Others
15	Others
16	Possibility of detected object is in the range 4096mm～5.6m
17	Others
18	Unspecified
19	Non-Measurable Distance

◆ Response to the Invalid Commands ◆

- There will be no response to the undefined commands.
- If there are any miss in commands or the byte count doesn't match, it will echo with error status.
- Command will echo with error code if there are any invalid commands such as, sending distance acquisition command when the laser is off or if starting point is bigger than the end point etc.