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Communication Protocol Specification
For
UST Series LA Type

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SYMBOL	AMENDED REASON			DATE	AMENDED BY	DWG.NO
APPROVED	CHECKED	DRAFTED	DESIGNED	TITLE	UST Series LA Type Communication Protocol Specification	
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1. Introduction

This document describes the specification of the communication protocol and control commands related to the UST Series LA type sensor. This specification is partly compliant with the Sensor Communication Interface Protocol (SCIP). Due to the nature of the sensor, some limitations are introduced to SCIP. For more information, please refer to the separate C-42-03320B¹ or C-42-03886². From now onward to distinguish this communication specification from SCIP, it will be referred as “SCIP-LA”.

2. Communication interface

This sensor uses one of the following communication interfaces.

● USB2.0

Transfer speed is full speed. Device class is compatible with Communication Device Class (CDC). It is recognized as a serial port (virtual COM port) from a host side. Access to the device from the application should be done only when the host-device configuration is complete and host recognizes the device. (When using USB connection, port should be opened only after the OS assigns the number to the device.)

● Ethernet 100BASE-T

TCP/IP is used for communication. The factory default for the network address settings are listed below.

IP address	:	192.168.0.10
Subnet mask	:	255.255.255.0
Default gateway	:	192.168.0.1
Port number	:	10940(Fixed)

● RS-422

Serial communication is performed using one-to-one communication basis.

Communication setting is as follows (Parity: None, Data bit: 8, Stop bit: 1, Flow control: None.)

Please refer to SS command for more information related to supported Bit Rate and Bit Rate switching.

Please refer to the product specification for more information related to the communication.

3. Communication sequence

A basic communication is described as the host sends a request message to the sensor, then the sensor reply with a response message to the host. There are two communication patterns: One response per request and multiple responses per request. The first is called “Handshake” and the second is called “Continuous”.

¹ <http://www.hokuyo-aut.jp/02sensor/07scanner/download/products/utm-30lx/>

² <http://www.hokuyo-aut.jp/02sensor/07scanner/download/products/utm-30lx-ew/>

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	2 / 14
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4. Communication format

All characters used for communication are ASCII code in addition to CR, LF.

(HOST→SENSOR)

Command	Parameter	String	Termination char (LF or CR or CR+LF)
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- Command : Consists of 2 characters. Each command will be explained later.
- Parameter : Depending on command, a parameter may be required. It will be explained in the section of each command.
- String : It is an optional item. Refer to the separate document (First page footnote) for more details.
- Termination char : Either LF(0aH), CR(0dH) or CR+LF could be the termination character.

(SENSOR→HOST)

Command	Parameter	String	LF
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Status	SUM	LF
--------	-----	----

Data	SUM	LF	LF
------	-----	----	----

- Command : The echo back of the data sent by the host to the sensor.
- Parameter : The echo back of the data sent by the host to the sensor.
- String : The echo back of the data sent by the host to the sensor.
- Status : Shows whether the processing of the command was successful or not.
- LF : LF(0aH) is used as a delimiter
- SUM : Used as a check code. Refer to the separate document (First page footnote) for more details.
- Data : If the data section includes more than 64bytes, LF will be inserted after every 64bytes.
- LFLF : The sensor sends 2 times LF to notify the host of the termination of the response.

5. Communication commands

The following commands are used for measurement acquisition:

- Distance acquisition command (GD,MD)
- Distance and intensity acquisition command (GE,ME)

The following commands are used for information acquisition

- Version acquisition (VV)
- Sensor's parameters acquisition (PP)
- Sensor's state information acquisition (II)

The following commands are used for sensor's state change

- Transition to measurement state (BM)
- Stop continuous mode and move to Normal measurement state³(QT)
- Sensor reboot (RB)
- Change Bit Rate (SS⁴)

³ Only the steps of predefined area will return to measurement status.

⁴ This command is only valid for RS-422.

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	3 / 14
-----------	--	----------------	-----------	--------

【GD Command】

The latest distance data is returned when this command is received. Before using this command, make sure the laser is activated for all steps and the measurement is started using “BM” command. However, in SCIP-LA, using this command without “BM” command will result in returning valid measurement for steps defined in the current area. Remaining steps would have error code. Please refer to the below table for distance error code.

Table: Error Codes

Error code	Error details
0xFFFF	Object out of range
0xFFFE	Object is too near
0xFFFFD	Object has low intensity
0xFFFFC	No object in the range
0	Not measurable steps

(HOST→SENSOR)

“GD”	Start step	End step	Cluster count	String	Termination char
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Start step : 4 digits decimal number representing the start step of distance acquisition of the area.

End step : 4 digits decimal number representing the end step of distance acquisition of the area.

Cluster count : 2 digits decimal number representing the cluster count step. Default value is “00”.

Set a suitable value to reduce the load during communication.

String/Termination char: Refer to the Communication Format Section.

Example) Use command “**GD0000010000↵**” to obtain distance data of all steps from step 0 to step 100

(SENSOR→HOST)

“GD”	Start step	End step	Cluster count	String	LF
------	------------	----------	---------------	--------	----

Status	SUM	LF
--------	-----	----

Time stamp	SUM	LF
------------	-----	----

Data	SUM	LF
------	-----	----

Data	SUM	LF	LF
------	-----	----	----

Status: Typically “00” is returned.

Time stamp : Sensor has an internal counter, its value is known as time stamp. Time stamp is a 24 bit integer value represented using 4 characters encoding. When this 24 bit counter runs over, it counts back from zero.

Data : 3 character encoded distance data. When the total data exceeds 64 bytes, LF mark and SUM are inserted after each block of 64 bytes.

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	4 / 14
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In SCIP, a character encoding method is used in order to compress the data sent to the host. It is defined as follows. Numbers are divided in groups of 6 bits. 30h value is added to each group. The result 6 bits encoding is ordered from high-order to low-order bits. After encoding, if the number of generated characters is two, then it is called "two characters encoding". If three characters, then it is called "three characters encoding" and if four characters, then it is called as "four characters encoding".

Example) Decoding of 3 character encoded distance data having "1Dh" as encoded value.

```

'1' (31h) 'D' (44h) 'h' (68h)
  ↓ Subtract 30h
  1h 14h 38h
  ↓ Merge
000001 010100 111000
  ↓ Decimal Value
  5432mm

```

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	5 / 14
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【MD Command】

The distance data obtained within the specified condition is returned when this MD command is received.

(HOST→SENSOR)

“MD”	Start step	End step	Cluster count	Scan Interval	No. of scans	String	Termination char
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Start step/End step/Cluster count: Refer to the GD command section.

Scan Interval : 1 digit decimal number representing the number of scan to skip. Default value is '0'. Set a suitable value to reduce the load during communication.

Number of scans : 2 digit decimal number representing the requested number of scan data. Use “00” to obtain continuous unlimited scans.

Example) Use command“**MD000001000000**” to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

- Initial response after the command is received

(SENSOR→HOST)

“MD”	Start step	End step	Cluster count	Scan interval	No. of scans	String	LF
------	------------	----------	---------------	---------------	--------------	--------	----

Status	SUM	LF	LF
--------	-----	----	----

Status : Typically “00” is returned.

- Continuous response of distance data

(SENSOR→HOST)

“MD”	Start step	End step	Cluster count	Scan interval	Remaining scan	LF
------	------------	----------	---------------	---------------	----------------	----

Status	SUM	LF
--------	-----	----

Time stamp	SUM	LF
------------	-----	----

Data	SUM	LF
------	-----	----

Data	SUM	LF	LF
------	-----	----	----

Status: Typically “99” is returned.

Time stamp/Data: Refer to the GD command section.

Measurement error: Refer to the GD command section.

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	6 / 14
-----------	--	----------------	-----------	--------

【GE Command】

GE command works the same way as GD command. The difference with GD command is that GE command returns not only distance data but also intensity.

(HOST→SENSOR)

“GE”	Start step	End step	Cluster count	String	Termination char
------	------------	----------	---------------	--------	------------------

Start step/End step/Cluster count: Refer to the GD command section.

(SENSOR→HOST)

“GE”	Start step	End step	Cluster count	String	LF
------	------------	----------	---------------	--------	----

Status	SUM	LF
--------	-----	----

Time stamp	SUM	LF
------------	-----	----

Data	SUM	LF
------	-----	----

Data	SUM	LF	LF
------	-----	----	----

Data: It is consists of distance data (Refer to the GD Command section) and intensity. All data are 3 characters encoded.

Intensity is the reflected strength of the laser. The reflected laser intensity value is represented by 18-bit data. It is a relative number without a unit. Intensity may differ depending upon the distance, material and detection angle of the object. Therefore, users should check the detection capability verification test.

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	7 / 14
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【ME Command】

ME command works the same way as MD command. The difference is similar to GE command as ME command returns also intensity.

(HOST→SENSOR)

“ME”	Start step	End step	Cluster count	Scan interval	Number of scans	String	Termination char
------	------------	----------	---------------	---------------	-----------------	--------	------------------

Start step/End step/Cluster count: Refer to the GD command section.

Scan interval/Number of scans: Refer to the GE command section.

- Initial response after the command is received.

(SENSOR→HOST)

“ME”	Start step	End step	Cluster count	Scan interval	Number of scans	String	LF
------	------------	----------	---------------	---------------	-----------------	--------	----

Status	SUM	LF	LF
--------	-----	----	----

Status: Typically “00” is returned.

- Continuous response of distance data and intensity

(SENSOR→HOST)

“ME”	Start step	End step	Cluster count	Scan interval	Remaining scan	LF
------	------------	----------	---------------	---------------	----------------	----

Status	SUM	LF
--------	-----	----

Time stamp	SUM	LF
------------	-----	----

Data	SUM	LF	LF
------	-----	----	----

Status: Typically “99” is received.

Time stamp: Refer to the GD command section.

Data: Refer to the GE command section

【BM Command】

This command is used to switch the sensor to measurement state, emission of the laser and to start measurement. However, in SCIP-LA, this command is used to switch from current area limited measurement into full field measurement state.

(HOST→SENSOR)

“BM”	String	LF	Termination char
------	--------	----	------------------

(SENSOR→HOST)

“BM”	String	LF
------	--------	----

Status	SUM	LF	LF
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Status: Typically “00” is returned.

Example) “BM↵”

【QT Command】

This command is used to stop the current measurement state and switch to idle state. However, in SCIP-LA, this command stops transmitting the data during continuous mode. Also, returns to normal state during the measurement of data with laser activated for all steps.

(HOST→SENSOR)

“QT”	String	Termination char
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(SENSOR→HOST)

“QT”	String	LF
------	--------	----

Status	SUM	LF	LF
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Status: Typically “00” is returned.

Example) “QT↵”

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	9 / 14
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【SS Command】

This command is used to change Bit Rate of the sensor when connected with serial communication (RS-422).

(HOST→SENSOR)

“SS”	Bit Rate	String	Termination char
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Bit Rate : Bit rate should be one of below setting ⁵. Changes will apply after the status “00” is returned.

115.2Kbps : “115200”

230.4Kbps : “230400”

460.8Kbps : “460800”

921.6Kbps : “921600”

(SENSOR→HOST)

“SS”	Bit rate	String	LF
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Status	SUM	LF	LF
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Status: Typically “00” is returned.

Example) “SS019200↵”

⁵ In future, other Bit rate may get supported.

TITL E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	10 / 14
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【VV Command】

This command is used to obtain version information of the sensor.

(HOST→SENSOR)

“VV”	String	Termination char
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(SENSOR→HOST)

“VV”	String	LF
------	--------	----

Status	SUM	LF
--------	-----	----

Vendor information	;	SUM	LF
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Product information	;	SUM	LF
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Firmware version	;	SUM	LF
------------------	---	-----	----

Protocol version	;	SUM	LF
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Serial number	;	SUM	LF	LF
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Status: Typically “00” is returned.

Example) “VV↵”

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	11 / 14
-----------	--	----------------	-----------	---------

【PP Command】

This command is used to obtain the information of sensor's parameter.

(HOST→SENSOR)

“PP”	String	Termination char
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(SENSOR→HOST)

“PP”	String	LF
------	--------	----

Status	SUM	LF
--------	-----	----

Sensor model	;	SUM	LF
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Minimum measureable distance(mm)	;	SUM	LF
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Maximum measureable distance(mm)	;	SUM	LF
----------------------------------	---	-----	----

Angular resolution (No. of partitions 360 degrees)	;	SUM	LF
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Starting step No.	;	SUM	LF
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End step No.	;	SUM	LF
--------------	---	-----	----

Step number of the front direction	;	SUM	LF
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Standard scanning speed (rpm)	;	SUM	LF
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Scan direction (“CW”or“CCW”)	;	SUM	LF	LF
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Status: Typically “00” is returned.

Example) “PP”

【II Command】

This command is used to obtain status information of the sensor. Also, error number is returned during error state.

(HOST→SENSOR)

“II”	String	Termination char
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(SENSOR→HOST)

“II”	String	LF
------	--------	----

Status	SUM	LF
--------	-----	----

Sensor model	;	SUM	LF
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Status of the laser	;	SUM	LF
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Scanning speed	;	SUM	LF
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Measurement mode	;	SUM	LF
------------------	---	-----	----

Speed of serial communication	;	SUM	LF
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Time stamp	;	SUM	LF
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Status of sensor	;	SUM	LF	LF
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Status: Typically “00” is returned.

During the error state of the sensor, error code is displayed after “STAT” in such a case, consider reporting it to our company including the contents of “II”, “VV” command response.

Example) “II↵”

T I T L E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	13 / 14
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【RB Command】

This command is used to reboot the sensor. However, it requires a special procedure to use it. Within 1 second, 2 request messages should be sent and their corresponding response message should be received. Otherwise, the sensor continues to be in the same state and does not reboot. However, in SCIP-LA, this RB command is only valid when sensor stops due to error.

(HOST→SENSOR)

“RB”	String	Termination char
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(SENSOR→HOST)

“RB”	String	LF
------	--------	----

Status	SUM	LF	LF
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Status: Typically, the 1st time “01” is returned. The 2nd time “00” is returned.

TITL E	UST Series LA Type Communication protocol	Drawing No.	C-42-4049	14 / 14
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