Communication Protocol Specification
For
UST Series 10LX/20LX
1. **Introduction**

This document describes the specification of the communication protocol and control commands related to the UST Series LX type sensor.

This specification is a communication protocol complying partly with the Sensor Communication Protocol (SCIP). Also, this sensor is designed to keep compatibility with the UTM-30LX-EW.

This document has been intended to briefly describe the typical command. If you need more information, please refer to the separate C-42-03886. Due to the nature of the sensor, not supported commands do exist. These commands will be listed at the end of the document.

2. **Communication interface**

The communication interface of this sensor is Ethernet interface.

- Ethernet 100BASE-T

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP address</td>
<td>192.168.0.10</td>
</tr>
<tr>
<td>Subnet mask</td>
<td>255.255.255.0</td>
</tr>
<tr>
<td>Default gateway</td>
<td>192.168.0.1</td>
</tr>
<tr>
<td>Port number</td>
<td>10940 (fixed)</td>
</tr>
</tbody>
</table>

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”.

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4. Communication format

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

\begin{tabular}{|c|c|c|c|}
\hline
\textbf{Command} & \textbf{Parameter} & \textbf{String} & \textbf{Termination char (LF or CR or CR+LF)} \\
\hline
\text{HOST→SENSOR} & Consists of 2 characters. Each command will be explained later. & & \\
\text{Parameter} & Depending on command, a parameter may be required. It will be explained in the & & \\
\text{section of each command.} & & & \\
\text{String} & It is an optional item. Refer to the separate document (First page footnote) for more & & \\
\text{Termination char} & Either LF(0aH), CR(0dH) or CR+LF could be the termination character. & & \\
\hline
\text{SENSOR→HOST} & The echo back of the data sent by the host to the sensor. & & \\
\text{Command} & The echo back of the data sent by the host to the sensor. & & \\
\text{Parameter} & The echo back of the data sent by the host to the sensor. & & \\
\text{String} & Shows whether the processing of the command was successful or not. & & \\
\text{Status} & LF(0aH) is used as a delimiter & & \\
\text{LF} & SUM : Used as a check code. Refer to the separate document (First page footnote) for more & & \\
\text{SUM} & details. & & \\
\text{Data} & If the data section includes more than 64 bytes, LF will be inserted after every 64 & & \\
\text{Data} & bytes. & & \\
\text{LFLF} & The sensor sends 2 times LF to notify the host of the termination of the response. & & \\
\hline
\end{tabular}

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 Idle State (QT)
Sensor initialization (RS,RT²)
Sensor reboot (RB)
Clock adjustment (TM³)

【GD Command】
The latest distance data is returned when this command is received. Before using this command, make sure you activated the laser for all steps and started the measurement using the “BM” command.

(HOST→SENSOR)

<table>
<thead>
<tr>
<th>“GD”</th>
<th>Start step</th>
<th>End Step</th>
<th>Cluster Count</th>
<th>String</th>
<th>Termination char</th>
</tr>
</thead>
</table>

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 “00”. Set the 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)

<table>
<thead>
<tr>
<th>“GD”</th>
<th>Start step</th>
<th>End Step</th>
<th>Cluster Count</th>
<th>String</th>
<th>LF</th>
</tr>
</thead>
</table>

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 values over run, it returns back to zero and count continuous.

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.

² Refer to C-42-03886 for more details.
³ Refer to C-42-03886 for more details.
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
```
【MD Command】
The distance data obtained within the specified condition is returned when this MD command is received.

**HOST→SENSOR**

<table>
<thead>
<tr>
<th>“MD”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>No. of Scans</th>
<th>String</th>
<th>Termination char</th>
</tr>
</thead>
</table>

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 “MD00000010000000” 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**

<table>
<thead>
<tr>
<th>“MD”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>No. of scans</th>
<th>String</th>
<th>LF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>SUM</td>
<td>LF</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Status:: Typically “00” is returned.

Continuous response of distance data

**SENSOR→HOST**

<table>
<thead>
<tr>
<th>“MD”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>Remaining scan</th>
<th>LF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>SUM</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time stamp</td>
<td>SUM</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>SUM</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>SUM</td>
<td>LF</td>
<td>LF</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Status: Typically “99” is returned.

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

<table>
<thead>
<tr>
<th>“ME”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>Number of scans</th>
<th>String</th>
<th>Termination char</th>
</tr>
</thead>
</table>

Start step/End step/Cluster count: Refer to the GD command section.
Scan interval/Number of scans: Refer to the MD command section.

Initial response after the command is received.

**SENSOR→HOST**

<table>
<thead>
<tr>
<th>“ME”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>Number of scans</th>
<th>String</th>
<th>LF</th>
</tr>
</thead>
</table>

Status: Typically “00” is returned.

Continuous response of distance data and intensity

**SENSOR→HOST**

<table>
<thead>
<tr>
<th>“ME”</th>
<th>Start step</th>
<th>End step</th>
<th>Cluster count</th>
<th>Scan Interval</th>
<th>Remaining scan</th>
<th>LF</th>
</tr>
</thead>
</table>

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.

\[(\text{HOST} \rightarrow \text{SENSOR})\]

<table>
<thead>
<tr>
<th>“BM”</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
</tr>
<tr>
<td>LF</td>
</tr>
<tr>
<td>Termination char</td>
</tr>
</tbody>
</table>

\[(\text{SENSOR} \rightarrow \text{HOST})\]

<table>
<thead>
<tr>
<th>“BM”</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
</tr>
<tr>
<td>LF</td>
</tr>
</tbody>
</table>

Status: Typically “00” is returned.
Example) “BM$	ext{\text{"\text{"\text{"}}}”$”

[QT Command]
This command is used to stop the current measurement state and switch to idle state.

\[(\text{HOST} \rightarrow \text{SENSOR})\]

<table>
<thead>
<tr>
<th>“QT”</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
</tr>
<tr>
<td>Termination char</td>
</tr>
</tbody>
</table>

\[(\text{SENSOR} \rightarrow \text{HOST})\]

<table>
<thead>
<tr>
<th>“QT”</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
</tr>
<tr>
<td>LF</td>
</tr>
</tbody>
</table>

Status: Typically “00” is returned.
Example) “QT$	ext{\text{"\text{"\text{"}}}”$”
【VV Command】

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

**(HOST→SENSOR)**

```
“VV” String Termination char
```

**(SENSOR→HOST)**

```
“VV” String LF
```

Status SUM LF

Vendor information : SUM LF

Product information : SUM LF

Firmware version : SUM LF

Protocol version : SUM LF

Serial number : SUM LF LF

Status: Typically “00” is returned.

Example) “VV 00”
【PP Command】

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

**(HOST→SENSOR)**

<table>
<thead>
<tr>
<th>“PP”</th>
<th>String</th>
<th>Termination char</th>
</tr>
</thead>
</table>

**(SENSOR→HOST)**

<table>
<thead>
<tr>
<th>“PP”</th>
<th>String</th>
<th>LF</th>
</tr>
</thead>
</table>

Status | SUM | LF |

Sensor model | SUM | LF |

Minimum measureable distance (mm) | SUM | LF |

Maximum measureable distance (mm) | SUM | LF |

Angular resolution (No. of partitions 360 degrees) | SUM | LF |

Staring step No. | SUM | LF |

End step No. | SUM | LF |

Step number of the front direction | SUM | LF |

Standard scanning speed (rpm) | SUM | LF |

Scan direction ("CW" or "CCW") | SUM | LF | LF |

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 malfunction state.

(HOST→SENSOR)

<table>
<thead>
<tr>
<th>“II”</th>
<th>String</th>
<th>Termination char</th>
</tr>
</thead>
</table>

(SENSOR→HOST)

<table>
<thead>
<tr>
<th>“II”</th>
<th>String</th>
<th>LF</th>
</tr>
</thead>
</table>

Status | SUM | LF |
Sensor model | SUM | LF |
Status of the laser | SUM | LF |
Scanning speed | SUM | LF |
Measurement mode | SUM | LF |
Speed of serial communication | SUM | LF |
Time stamp | SUM | LF |
Status of sensor | SUM | LF | LF |

Status: Typically “00” is returned.

Example) “II00”
【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.

(HOST→SENSOR)
“RB” String Termination char

(SENSOR→HOST)
“RB” String LF

Status SUM LF LF

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

6. Response to Invalid Commands
This sensor is not compatible with multi echo function. Therefore, commands related to multi echo function such as “HD”, “HE”, “ND”, “NE” will not be accepted. Also, this sensor is a long distance type sensor. It will not answer to distance command of 2 characters encoding such as “MS” and “GS”.