

Date: 2025/11/05

# UCT series SCIP Communication Protocol Specification

SYMBOL	AMENDED REASON			PAGES	DATE	AMENDED BY REFERENCE
APPROVED	CHECKED	DRAFTED	DESIGNED	TITLE	UCT series SCIP Communication Protocol Specification	
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## 1 Introduction

This document describes the Sensor Communication Interface Protocol (SCIP) and the control command set for the UCT series. The specification conforms to the SCIP protocol.

## 2 Communication interface

The product communicates over Ethernet and supports TCP/IP and UDP/IP.

Factory default network settings are as follows:

Item	Default	Notes
IP Address	192.168.0.10	(Changeable via IPDiscovery, URGBenri)
Subnet Mask	255.255.255.0	(Changeable via IPDiscovery, URGBenri)
Default Gateway	192.168.0.1	(Changeable via IPDiscovery, URGBenri)
Port	10940 (fixed)	—
UDP Destination Address	192.168.0.100	(Changeable via AreaDesignerPrime)

## 3 Data Notation Format

Data notation in this specification is defined as follows:

Notation	Meaning
'A'	A fixed, readable character of length 1.
"ABC"	A fixed string whose content is constant.
C(n)	A readable string of length n bytes. (e.g., C(4): 4 readable characters)
C(*)	A variable-length readable string.
LF	Line Feed = 0x0A.
CR	Carriage Return = 0x0D.
RT	Terminator; one of LF, CR, or LF+CR.

## 4 Communication sequence

The host transmits a request message to the sensor, and the sensor returns a response message. By default, one response corresponds to one request (“handshake”). Some commands, however, stream multiple responses for a single request (“continuous/streaming mode”).

## 5 Communication format

All characters are ASCII. Newlines use CR, LF, or CR+LF. Unless otherwise noted, numeric values are decimal.

### (HOST→SENSOR)

Command C(2)	Parameter C(*)	;'String C(*)	RT
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- Command: Two characters. See each command description.
- Parameters: Presence depends on the command.
- ';' String: User-defined string up to 16 characters following ';'. Optional.

### (SENSOR→HOST)

Command C(2)	Parameter C(*)	;'String C(*)	LF
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Status C(2)	SUM C(1)	LF
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Data C(*)	SUM C(1)	LF	LF
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- Command / Parameters / ';' String: Echo-back of what the host sent.
- LF: Used as a delimiter.
- Status: Indicates whether the command was processed successfully. There are common status codes and command-specific ones.

#### Common status codes:

Code	Meaning
00	Accepted
0L	Rejected due to abnormal state
0M	Rejected due to degraded state
0E	Command format error
0F	Unsupported command
10	Not acceptable in current state
0G	User string length exceeded
0H	Invalid user string
0C	Command length too short
0D	Command length too long

- SUM: Checksum. See the Checksum section for details.
- Data: Command-specific payload. If the data exceeds 64 bytes, it is split every 64 bytes with LF delimiters. If no data exists or in abnormal states, LF+LF follows immediately after the status block.

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## 6 6-bit Encoding

A 6-bit integer (0–63, 0x00–0x3F) is offset by 0x30 and mapped to an ASCII character (0x30–0x6F). This is referred to as “6-bit encoding”.

- Example: Encoding value 26 (0x1A) using 6-bit encoding  
 $0x1A + 0x30 = 0x4A$ .  
0x4A corresponds to the ASCII character ‘J’.

## 7 Character Encoding for Numeric Compression

Numeric values in responses and scan data are non-negative integers encoded using character encoding for bandwidth reduction. The integer is split into 6-bit chunks, each 6-bit value is 6-bit encoded, and characters are ordered from the most significant chunk. We refer to them as "2-character", "3-character", or "4-character" encodings depending on the number of resulting characters.

- Example: Encoding the value 1234 (0x4D2).  
0100 1101 0010 → 010011 010010 → 0x13, 0x12 → 'C', 'B'.
- Example: Decode the characters 'CB'  
'C'(0x43)→0x13, 'B'(0x42)→0x12 → 010011 010010 → 1234 (0x4D2).

## 8 Checksum

The checksum is calculated by summing the ASCII codes of the target string, taking the lower 6 bits, then 6-bit encoding it. In responses, the target string is the substring between delimiters; the checksum character is inserted immediately after the target and before the delimiter.

- Example: 'ABC012' Sum = 0x159→lower 6 bits = 0x19  
 $0x19 + 0x30 = 0x49$  ('I').

## 9 Time data

The sensor keeps an internal count-up timer (“time”). This is used for timestamp fields and time queries.

- Format: 24-bit positive integer, encoded as a 4-character value with checksum and delimiters.
- Overflow: Resets to 0 after reaching the 24-bit maximum and continues counting.

### **【Time data】**

Timestamp C(4)

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## 10 Measurement data

### 10.1 Step data

A single scan consists of measurement data per step (or per group if grouping is specified). Step data formats:

- Distance data
- Distance–intensity pair
- Multi-echo distance data
- Multi-echo distance–intensity pair

#### ① Distance data

Distances are positive integers in millimeters up to 262,143 mm (18-bit). This model uses 3-character encoding. If the measured distance exceeds the sensor's upper limit, the upper limit value is returned.

##### **【Distance data】**

distance C(3)
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#### ② Distance–intensity pair

Returns distance with received light intensity. Intensity is an 18-bit value (max 262,143) encoded as 3 characters. Intensity is a relative value dependent on internal circuitry and does not represent absolute energy. A pair consists of distance C(3) followed by intensity C(3).

##### **【Distance–intensity pair】**

distance C(3)	Intensity C(3)
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#### ③ Multi-echo distance data

For each step, multiple reflections can be received. When step grouping is specified, the group returns the multi-echo data of the step with the smallest distance. Ordering: ascending by distance. Separator: '&' between echoes (omitted if only one). The maximum number of echoes per step is sensor dependent.

##### **【Multi-echo distance data】**

First Group (3 echoes)					Second Group (1 echo)	Third Group (2 echoes)		
distance C(3)	'&'	distance C(3)	'&'	distance C(3)	distance C(3)	distance C(3)	'&'	distance C(3)

#### ④ Multi-echo distance-intensity pair

Returns distance-intensity pairs in multi-echo format using the same ordering and '&' separators.

##### **【Multi-echo distance-intensity pair】**

First Group (2 echoes)					Second Group (1 echo)	
distance C(3)	intensity C(3)	'&'	distance C(3)	intensity C(3)	distance C(3)	intensity C(3)

### 10.2 Scan Data and Block Splitting

One response contains one scan. For distance or distance-intensity data, the total length depends on the number of steps. For multi-echo, the length varies per measurement. To limit line length, data are split every 64 characters with an LF and a checksum.

##### **【Scan data】**

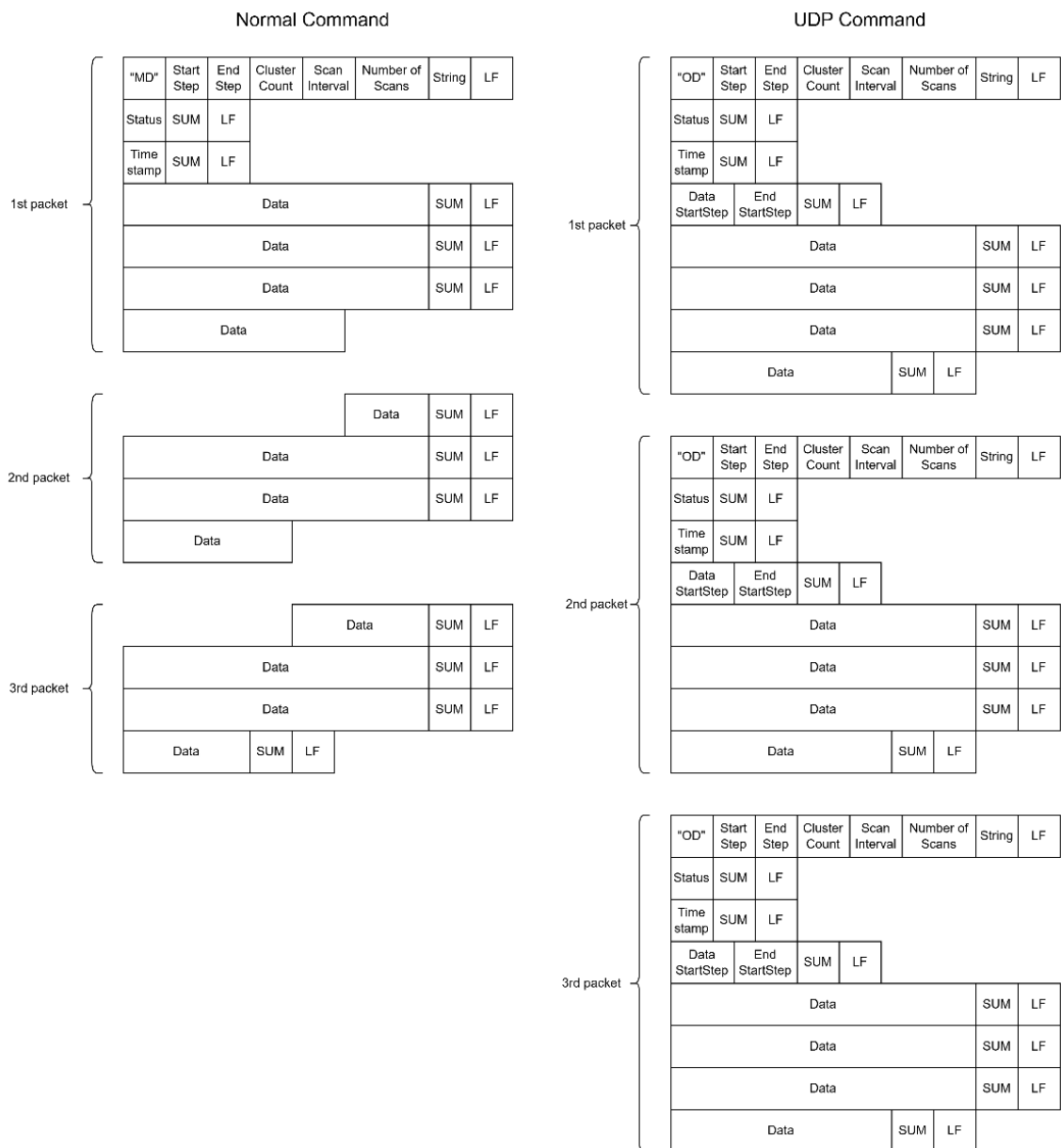
First Block C(64)	SUM C(1)	LF
Second Block C(64)	SUM C(1)	LF
Third Block C(64)	SUM C(1)	LF
· · ·		
Last Block C(*)	SUM C(1)	LF

### 10.3 Layer Information

In all-layer continuous mode, scan data are sent in the order Layer1 → Layer2 → Layer3. In handshake mode, the data corresponds to the layer measured just before receiving the command. Layer is identifiable by the lower 2 bits of the intensity value: 00=Layer1, 01=Layer2, 10=Layer3.

## 10.4 UDP-supported Commands

For UDP, measurement data are split into packets by step count so as not to exceed MSS when considering max echoes. Each packet includes a measurement range and a timestamp, so partial reception remains usable.



## 11 Commands

Command availability depends on operation mode (LA/LX) and transport (TCP/UDP). See the list below.

Name	Contents	Command support			
		LA mode		LX mode	
		TCP	UDP	TCP	UDP
GD	Distance acquisition (handshake)	○	△ <sup>3</sup>	○	△ <sup>3</sup>
MD	Distance acquisition (continuous stream)	○	△ <sup>3</sup>	○	△ <sup>3</sup>
OD	Distance acquisition (continuous stream)	×	○	×	○
GE	Distance & intensity acquisition (handshake)	○	△ <sup>3</sup>	○	△ <sup>3</sup>
ME	Distance & intensity acquisition (continuous stream)	○	△ <sup>3</sup>	○	△ <sup>3</sup>
OE	Distance & intensity acquisition (continuous stream)	×	○	×	○
HD	Multi-echo distance acquisition (handshake)	×	×	○	△ <sup>3</sup>
ND	Multi-echo distance acquisition (continuous stream)	×	×	○	△ <sup>3</sup>
PD	Multi-echo distance acquisition (continuous stream)	×	×	×	○
HE	Multi-echo distance & intensity acquisition (handshake)	×	×	○	△ <sup>3</sup>
NE	Multi-echo distance & intensity acquisition (continuous stream)	×	×	○	△ <sup>3</sup>
PE	Multi-echo distance & intensity acquisition (Ctrl, continuous stream)	×	×	×	○
VV	Version acquisition	○	○	○	○
PP	Sensor parameter information acquisition	○	○	○	○
II	Sensor status information acquisition	○	○	○	○
%ST	Sensor status acquisition	○	○	○	○
BM	Transition to full-area measurement mode	○	○	○	○
QT	Stop continuous transmission and transition to standby mode	△ <sup>4</sup>	△ <sup>4</sup>	○	○
%SL	Transition to sleep mode	×	×	○	×
RS	Sensor initialization	×	×	○	×
RB	Sensor reboot	△ <sup>5</sup>	×	○	×
TM	Clock adjustment	×	×	○	×

<sup>3</sup> Not recommended because packet loss is not taken into account.

<sup>4</sup> If a detection area is configured, the light is not turned off.

<sup>5</sup> Accepted only in the event of a failure.

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## 11.1GD Command

Returns the latest distance data at the receive time. Requires prior 'BM' to start laser emission and measurement.

### (HOST→SENSOR)

"GD"	Start step C(4)	End Step C(4)	Cluster Count C(2)	String C(*)	RT
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- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- String: Refer to the Communication Format section.

Example) Use the command "GD0000010000␣" to obtain distance data of all steps from step 0 to step 100

### (SENSOR→HOST)

"GD"	Start step C(4)	End Step C(4)	Cluster Count C(2)	String C(*)	LF
------	-----------------	---------------	--------------------	-------------	----

Status C(2)	SUM C(1)	LF
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Timestamp C(4)	SUM C(1)	LF
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Data C(64)	SUM C(1)	LF
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Data C(*)	SUM C(1)	LF	LF
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- Status: Typically "00" is returned.
- Timestamp: Time data.
- Data: Distance data.

## 11.2 MD Command

Streams distance data after reception under specified conditions.

### (HOST→SENSOR)

“MD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	RT
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- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value “00”. Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is ‘0’. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use “00” to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command “MD0000010000000” to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

“MD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
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- Status: Typically “00” is returned.

### (SENSOR→HOST) Continuous response of distance data

“MD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
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Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
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- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, “00” is returned.
- Status: Typically “99” is returned.
- Timestamp: Time data.
- Data: Distance data.

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## 11.3OD Command

Streams distance data via UDP with per-packet range info.

### (HOST→SENSOR)

“OD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
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- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value “00”. Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is ‘0’. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use “00” to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command “OD0000010000000↵” to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

“OD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically “00” is returned.

### (SENSOR→HOST) Continuous response of distance data

“OD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data start step C(4)	No. of steps C(4)	SUM C(1)	LF
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Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, “00” is returned.
- Status: Typically “99” is returned.
- Timestamp: Time data.
- Data start step: Step number of the first data in this packet.
- No. of steps: Number of data steps in this packet.
- Data: Distance data.

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## 11.4GE Command

Returns the latest distance-intensity pairs. Requires prior 'BM'.

### (HOST→SENSOR)

"GE"	Start step C(4)	End step C(4)	Cluster count C(2)	String C(*)	RT
------	-----------------	---------------	--------------------	-------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"GE"	Start step C(4)	End step C(4)	Cluster count C(2)	String C(*)	LF
------	-----------------	---------------	--------------------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Status: Typically "00" is returned.
- Timestamp: Time data.
- Data: Distance-intensity pair.

## 11.5ME Command

Streams distance–intensity pairs after reception under specified conditions.

### (HOST→SENSOR)

“ME”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	RT
------	-----------------	---------------	--------------------	--------------------	-------------------	-------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value “00”. Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is ‘0’. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use “00” to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

### (SENSOR→HOST) Initial response after the command is received

“ME”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	-----------------	---------------	--------------------	--------------------	-------------------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically “00” is returned.

### (SENSOR→HOST) Continuous response of distance data

“ME”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	-----------------	---------------	--------------------	--------------------	----------------------	----

Status C(2)	SUM C(1)	LF
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Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, “00” is returned.
- Status: Typically “99” is returned.
- Timestamp: Time data.
- Data: Distance-intensity pair.

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## 11.6OE Command

Streams distance–intensity pairs via UDP with per-packet range info.

### (HOST→SENSOR)

“OE”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value “00”. Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is ‘0’. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use “00” to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command “OE00000100000000↵” to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

“OE”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically “00” is returned.

### (SENSOR→HOST) Continuous response of distance data

“OE”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data start step C(4)	No. of steps C(4)	SUM C(1)	LF
----------------------	-------------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, “00” is returned.
- Status: Typically “99” is returned.
- Timestamp: Time data.
- Data start step: Step number of the first data in this packet.
- No. of steps: Number of data steps in this packet.
- Data: Distance-intensity pair.

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## 11.7HD Command

Returns the latest multi-echo distance data. Requires prior 'BM'.

### (HOST→SENSOR)

"HD"	Start step C(4)	End Step C(4)	Cluster Count C(2)	String C(*)	RT
------	-----------------	---------------	--------------------	-------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- String: Refer to the Communication Format section.

Example) Use the command "HD0000010000␣" to obtain distance data of all steps from step 0 to step 100

### (SENSOR→HOST)

"HD"	Start step C(4)	End Step C(4)	Cluster Count C(2)	String C(*)	LF
------	-----------------	---------------	--------------------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Status: Typically "00" is returned.
- Timestamp: Time data.
- Data: Multi-echo distance data.

## 11.8ND Command

Streams multi-echo distance data after reception under specified conditions.

### (HOST→SENSOR)

"ND"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	RT
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is '0'. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use "00" to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command "ND00000100000000" to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

"ND"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

### (SENSOR→HOST) Continuous response of distance data

"ND"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, "00" is returned.
- Status: Typically "99" is returned.
- Timestamp: Time data.
- Data: Multi-echo distance data.

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## 11.9PD Command

Streams multi-echo distance data via UDP with per-packet range info.

### (HOST→SENSOR)

“PD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value “00”. Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is ‘0’. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use “00” to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command “PD00000100000000↵” to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

“PD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically “00” is returned.

### (SENSOR→HOST) Continuous response of distance data

“PD”	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
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Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data start step C(4)	No. of steps C(4)	SUM C(1)	LF
----------------------	-------------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, “00” is returned.
- Status: Typically “99” is returned.
- Timestamp: Time data.
- Data start step: Step number of the first data in this packet.
- No. of steps: Number of data steps in this packet.
- Data: Multi-echo distance data.

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## 11.10 HE Command

Returns the latest multi-echo distance-intensity pairs. Requires prior 'BM'

### (HOST→SENSOR)

"HE"	Start step C(4)	End step C(4)	Cluster count C(2)	String C(*)	RT
------	-----------------	---------------	--------------------	-------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"HE"	Start step C(4)	End step C(4)	Cluster count C(2)	String C(*)	LF
------	-----------------	---------------	--------------------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Status: Typically "00" is returned.
- Timestamp: Time data.
- Data: Multi-echo distance-intensity pair.

## 11.11 NE Command

Streams multi-echo distance-intensity pairs after reception under specified conditions.

### (HOST→SENSOR)

"NE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	RT
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is '0'. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use "00" to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

### (SENSOR→HOST) Initial response after the command is received

"NE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

### (SENSOR→HOST) Continuous response of distance data

"NE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, "00" is returned.
- Status: Typically "99" is returned.
- Timestamp: Time data.
- Data: Multi-echo distance-intensity pair.

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## 11.12 PE Command

Streams multi-echo distance-intensity pairs via UDP with per-packet range info.

### (HOST→SENSOR)

"PE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

- Start step: The start step of the distance acquisition of the area.
- End step: The end step of the distance acquisition of the area.
- Cluster count: Default value "00". Set a suitable value to reduce the load during communication.
- Scan Interval: The number of scans to skip. Default value is '0'. Set a suitable value to reduce the load during communication.
- Number of scans: The requested number of scans. Use "00" to obtain continuous unlimited scans.
- String: Refer to the Communication Format section.

Example) Use the command "PE0000010000000" to obtain unlimited distance data of all steps from step 0 to step 100 without skipping scans

### (SENSOR→HOST) Initial response after the command is received

"PE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	No. of scans C(2)	String C(*)	LF
------	--------------------	------------------	-----------------------	-----------------------	----------------------	----------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

### (SENSOR→HOST) Continuous response of distance data

"PE"	Start step C(4)	End step C(4)	Cluster count C(2)	Scan Interval C(1)	Remaining scans C(2)	LF
------	--------------------	------------------	-----------------------	-----------------------	-------------------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF
----------------	----------	----

Data start step C(4)	No. of steps C(4)	SUM C(1)	LF
----------------------	-------------------	----------	----

Data C(64)	SUM C(1)	LF
------------	----------	----

Data C(*)	SUM C(1)	LF	LF
-----------	----------	----	----

- Remaining scans: The number of scans remaining. If an unlimited number of scans is specified, "00" is returned.
- Status: Typically "99" is returned.
- Timestamp: Time data.
- Data start step: Step number of the first data in this packet.
- No. of steps: Number of data steps in this packet.
- Data: Multi-echo distance-intensity pair.

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### 11.13 VV Command

Returns vendor/product/version/protocol/serial information.

#### (HOST→SENSOR)

"VV"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

#### (SENSOR→HOST)

"VV"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Vendor information C(*)	;	SUM C(1)	LF
-------------------------	---	----------	----

Product information C(*)	;	SUM C(1)	LF
--------------------------	---	----------	----

Firmware version C(*)	;	SUM C(1)	LF
-----------------------	---	----------	----

Protocol version C(*)	;	SUM C(1)	LF
-----------------------	---	----------	----

Serial number C(*)	;	SUM C(1)	LF	LF
--------------------	---	----------	----	----

- Status: Typically "00" is returned.

Example) "VV↵"

## 11.14 PP Command

Returns sensor parameters such as range, angular resolution, step numbers, and nominal scan speed.

### (HOST→SENSOR)

"PP"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"PP"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Sensor model C(*)	;	SUM C(1)	LF
-------------------	---	----------	----

Minimum measurable distance (mm) C(*)	;	SUM C(1)	LF
---------------------------------------	---	----------	----

Maximum measurable distance (mm) C(*)	;	SUM C(1)	LF
---------------------------------------	---	----------	----

Angular resolution(No. of partitions in 360 degrees) C(*)	;	SUM C(1)	LF
---	---	----------	----

Starting step No. C(*)	;	SUM C(1)	LF
------------------------	---	----------	----

End step No. C(*)	;	SUM C(1)	LF
-------------------	---	----------	----

Step number of the front direction C(*)	;	SUM C(1)	LF
---	---	----------	----

Standard scanning speed (rpm) C(*)	;	SUM C(1)	LF
------------------------------------	---	----------	----

- Status: Typically "00" is returned.

Example) "PP↵"

## 11.15 II Command

This command is used to obtain status information of the sensor. It also returns an error number when a malfunction occurs.

### (HOST→SENSOR)

"II"	String C(*)	RT
------	-------------	----

➤ String: Refer to the Communication Format section.

### (SENSOR→HOST)

"II"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Sensor model C(*)	;	SUM C(1)	LF
-------------------	---	----------	----

Status of the laser C(*)	;	SUM C(1)	LF
--------------------------	---	----------	----

Scanning speed C(*)	;	SUM C(1)	LF
---------------------	---	----------	----

Measurement mode C(*)	;	SUM C(1)	LF
-----------------------	---	----------	----

Speed of serial communication C(*)	;	SUM C(1)	LF
------------------------------------	---	----------	----

Timestamp C(*)	;	SUM C(1)	LF
----------------	---	----------	----

Status of sensor C(*)	;	SUM C(1)	LF	LF
-----------------------	---	----------	----	----

➤ Status: Typically "00" is returned.

Example) "II␣"

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## 11.16 %ST Command

Returns current sensor state code.

### (HOST→SENSOR)

"%ST"	String C(*)	RT
-------	-------------	----

- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"%ST"	String C(*)	LF
-------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Sensor status C(3)	SUM C(1)	LF	LF
--------------------	----------	----	----

- Status: Typically "00" is returned.

Code	State
000	Standby
100	Standby (degraded)
001	Booting
002	Time sync
102	Time sync (degraded)
003	Measuring
103	Measuring (degraded)
004	Responding with measurement
104	Responding with measurement (degraded)
005	Sleep
006	Waking from sleep
900	Fault detected

## 11.17 BM Command

Transitions the sensor to measurement state and turns on laser emission. In LA mode, the emission region is set to all steps.

### (HOST→SENSOR)

"BM"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"BM"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

Example) "BM␣"

### 11.18 QT Command

Stops streaming and transitions to standby. In LA mode, transitions to area-only measurement.

#### (HOST→SENSOR)

"QT"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

#### (SENSOR→HOST)

"QT"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

Example) "QT↵"

### 11.19 RS Command

Stops measurement, transitions to standby, and resets the timestamp to 0.

#### (HOST→SENSOR)

"RS"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

#### (SENSOR→HOST)

"RS"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

### 11.20 RB Command

Reboots the sensor. Requires a special handshake: two round-trips of RB request/response within 1 second. If not satisfied, a reboot does not occur, and the current state is retained.

#### (HOST→SENSOR)

"RB"	String C(*)	RT
------	-------------	----

- String: Refer to the Communication Format section.

#### (SENSOR→HOST)

"RB"	String C(*)	LF
------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

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

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## 11.21 TM Command

Used for clock synchronization. TM0 enters time-sync state; TM1 returns timestamp immediately regardless of scan state; TM2 exits time-sync and returns to standby. The host should compensate for the communication delay and align with the system time.

### (HOST→SENSOR)

"TM0"	String C(*)	RT
-------	-------------	----

- String: Refer to the Communication Format section.

### (SENSOR→HOST)

"TM0"	String C(*)	LF
-------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----

- Status: Typically "00" is returned.

### (HOST→SENSOR)

"TM1"	String C(*)	RT
-------	-------------	----

### (SENSOR→HOST)

"TM1"	String C(*)	LF
-------	-------------	----

Status C(2)	SUM C(1)	LF
-------------	----------	----

Timestamp C(4)	SUM C(1)	LF	LF
----------------	----------	----	----

- Timestamp: Time data.

### (HOST→SENSOR)

"TM2"	String C(*)	RT
-------	-------------	----

### (SENSOR→HOST)

"TM2"	String C(*)	LF
-------	-------------	----

Status C(2)	SUM C(1)	LF	LF
-------------	----------	----	----