



SE2L Series  
Safety Laser Scanner

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**SE2L Series  
Safety Laser Scanner  
Communication Manual**

## Safety Precautions

In this manual, safety precautions are categorized depending on the severity as Warning or Caution:



### WARNING

Warning notices are used to emphasize that improper operation may cause severe personal injury or death.



### CAUTION

Caution notices are used where inattention might cause personal injury or damage to equipment.



### WARNING

- Sending commands other than those specified in this document can lead to unintended performance of SE2L causing critical injury or death.
- Sending commands in sequence other than those specified in this document can lead to unintended performance of SE2L causing critical injury or death.
- Data obtained through communication should not be used for controlling the safety device.
- Verification shall be done to ensure that the data output does not hamper the safety operation of either SE2L or the controlled device.



### CAUTION

- Data integrity (size, CRC, status etc.) shall be sufficiently checked before using the data for the intended purpose.

## Preface

- This document describes the communication protocol manual for the safety laser scanner, SE2L-HA05LP/SE2L-HA05LPC (henceforth SE2L).
- This specification is intended for the developers who have sufficient knowledge on the product and software programming.
- Read this document and user's manual of SE2L carefully before programming the communication software.
- Information provided in this document is subject to change without prior notice. For the latest information visit the company's website.

## □ Publication History

First edition published in December 2024.

## Symbols used in this manual

This manual uses the following symbols to facilitate explanation.



Information that requires special attention. Failure to operate the product in accordance with the information provided can lead to serious injury or damage.

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## Contents

Chapter 1 Overview .....	5
Chapter 2 Abbreviations and Descriptions .....	6
Chapter 3 Communication Format .....	7
Chapter 4 Data Encoding and Decoding .....	8
Chapter 5 CRC Calculation .....	9
Chapter 6 Commands .....	10
6.1 Version Details (VR Command) .....	10
6.2 Sensing Data (AR Commands) .....	11
6.2.1 AR00 Command .....	13
6.2.2 AR01 Command .....	14
6.2.3 AR02 Command .....	14
6.2.4 AR03 Command .....	14
6.2.5 AR04 Command .....	15
6.2.6 AR05 Command .....	15
6.2.7 AR06 Command .....	16
6.2.8 AR07 Command .....	16
6.2.9 AR08 Command .....	17
6.3 Status Data (XR Commands) .....	18
6.4 Area Data (YR Commands) .....	19
6.5 Detection Log Command .....	20
6.5.1 Detection Log Read (DL00 Command) .....	20
6.5.2 Detection Log Clear (DC00 Command) .....	22
6.5.3 Detection Log Read(DL01/DL02 Command) .....	22
6.6 Configuration ID (ID Command) .....	23
6.7 Reboot Device (SB Command) .....	23
Chapter 7 Reply Status .....	24
Chapter 8 Protocol Mode Communication .....	25
8.1 B Protocol Format .....	25
8.1.1 Request Message .....	25
8.1.2 Response Message .....	26
8.1.3 Scan Response Message .....	27
8.2 B Protocol Encoding and Decoding .....	28
8.3 Check Code .....	28
8.4 Timestamp .....	28
8.5 Data Splitting .....	29
8.6 Common B Protocol Status Codes .....	29
8.7 B Protocol Commands .....	30
8.7.1 BM Command .....	30
8.7.2 Measurement Data (GD and GE Command) .....	30
8.7.3 Measurement Data (MD and ME Command) .....	32
8.7.4 Continuous Transmission Terminate (QT, RS and RT Command) .....	35
8.7.5 Sensor Information (VV, PP and II Commands) .....	36
8.7.6 Reboot Device (RB Command) .....	38

# Chapter 1 Overview

SE2L can communicate with a host computer such as PC and PLC via Ethernet as a TCP communication server and output the following data by using an optional Ethernet cable.

- Sensing Data
- Status (OSSD, etc.)
- Area setting
- Detection log
- Configuration ID
- Sensor information (version, etc.)

SE2L can also be restarted from a host computer.

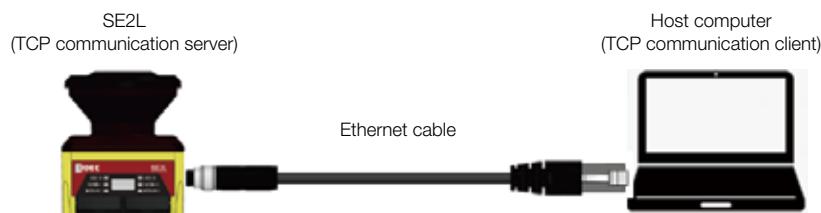


Figure 1 Ethernet communication configuration

Ethernet communication settings (IP address, subnet mask, default gateway, port number, and TCP retransmission time) can be changed by SLS Project Designer.

Communication protocol is a predefined format of ASCII strings used for data transmission between host computer and SE2L referred as, "Command" and "Reply". Commands are sent from the host computer to SE2L which will then reply with the data corresponding to the type of command. Protocol should be strictly followed in order to obtain the appropriate data. Set of such commands and their responses are explained in this document.

**This manual is compatible with firmware version 1.1.1o (and later) of SE2L.**



- Do not perform Ethernet and USB communication simultaneously. If Ethernet is connected, stop the Ethernet transmission when configuring the SE2L with USB device or SD card.
- As a measure to avoid the effect of electric noise, UAM resets the Ethernet PHY every 10 seconds when it is not connected to the host. Connection fails to establish during the reset process. Therefore, try to connect multiple times with the sufficient timeout when connecting with the SE2L.
- When SE2L detects error, it saves the information in the ROM. During this period communication may stop briefly.

## Chapter 2 Abbreviations and Descriptions

AGV: Automated guided vehicle

CRC: Cyclic Redundancy Check

STX: Start of Text

ETX: End of Text

OSSD: Output Signal Switching Device

# Chapter 3 Communication Format

General communication format and terms used in it are explained below.

## Command

### Host » SE2L

STX 1 char	Command Size 4 char	Header 2 char	Sub Header 2 chars	CRC 4 char	ETX 1 char
---------------	------------------------	------------------	-----------------------	---------------	---------------

## Reply

### Host « SE2L

STX 1 char	Reply Size 4 char	Header 2 char	Sub Header 2 chars	Status 2 char	Data <sup>1</sup> N char	CRC 4 char	ETX 1 char
---------------	----------------------	------------------	-----------------------	------------------	-----------------------------	---------------	---------------

<sup>1</sup> Some of the replies may not contain this field.

#### Command:

It is the data transmitted from the host computer to SE2L. It is enclosed between STX and ETX and contains Command Size, Header, Sub-Header and CRC.

#### Command Size:

It is the total length of ASCII characters in a command. Command size is encoded to hexadecimal strings (refer to section 4).

#### Header:

It is a unique code to differentiate the type of command.

#### Sub-Header:

It is an additional parameter to differentiate the same command having multiple replies.

#### CRC:

It is a 16-Bit code for checking the data integrity. Command size, header, sub-header and data are included in CRC calculation (refer to section 5). CRC is encoded to hexadecimal strings (refer to section 4)

#### Reply:

It is the data transmitted from SE2L to host computer upon receiving a command. It is enclosed between STX and ETX and contains Reply size, Header, Sub-Header, Data, Status and CRC. Reply is unique for each command.

#### Reply Size:

It is the total length of ASCII characters in a reply. Reply size is encoded to hexadecimal strings (refer to section 4).

#### Status:

It is a code to inform the success or failure of the command execution. Status other than "00" is error code. Refer to section 7 for details.

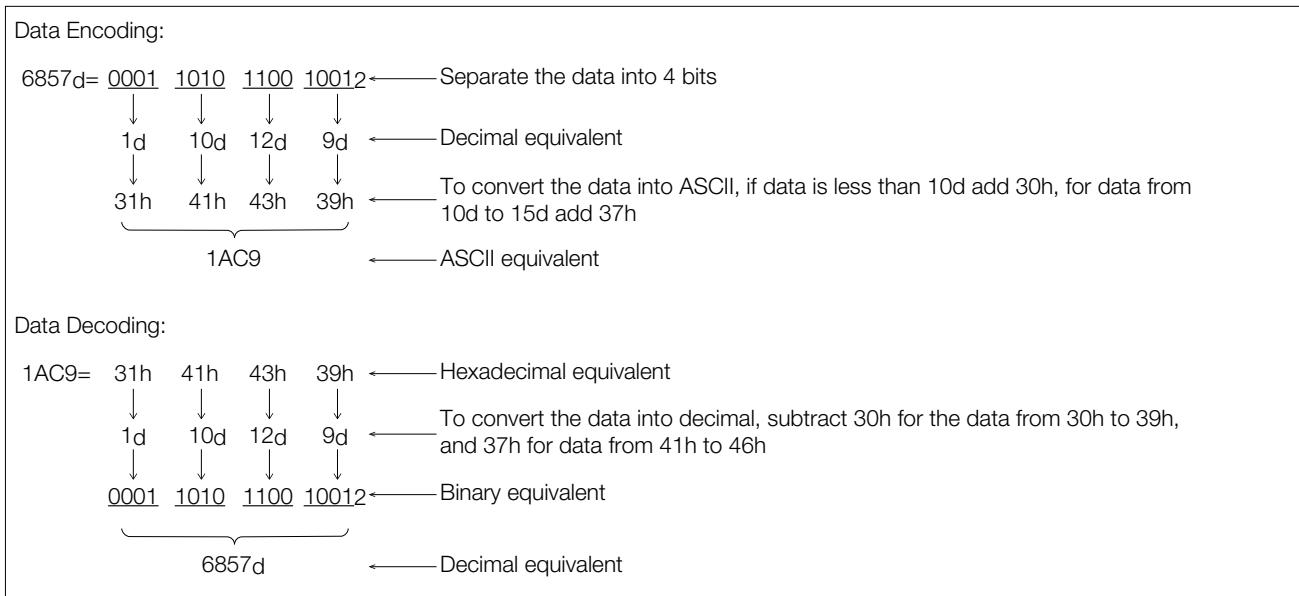
#### Data:

Data is SE2L's internal state and/or measurement values. It is encoded in ASCII strings and transmitted from SE2L. Some of the replies may not contain the data.

# Chapter 4 Data Encoding and Decoding

Data encoding is applied in the communication protocol. Host computer should convert all the numerical values into ASCII characters before transmitting them to SE2L. For encoding, the data should be first divided into 4 bits, and then depending on its value, either 30h or 37h is added to convert into ASCII characters (Figure 4.1). Values received from SE2L are also in the same format therefore, program on the host computer should decode it before using. Decoding is exactly the opposite of encoding process where, depending on the value of each received ASCII characters.

Figure 4.1 Data Encoding and Decoding



# Chapter 5 CRC Calculation

CRC is a 16 bit code to check the data integrity at the receiving end. It serves as a mean to detect corruption or loss during transmission that may occur due to noise in the communication channel. When SE2L receives data from the host computer, it recalculates the CRC and compares it with the CRC value in the command. SE2L will reply with the requested data only if both CRCs match otherwise, it will reply with an error code in the status. Data integrity check should be also applied on the host computer before using the received data. Discard the data if verification fails and try again by resending the command.

CRC is calculated using the polynomial  $X^{16}+X^{12}+X^5+1$ . CRC value is encoded into 4 ASCII characters (see section 4) before the transmission. STX and ETX are not included when calculating the CRC value.

CRC Standard: Kermit

Polynomial: 0x1021

Shift Direction: Right

Initial Value: 0x0000

Byte Swap: Yes

Reverse CRC Result: Yes

## **CRC Example:**

Data→“000EVR00”: 0x3492←CRC

# Chapter 6 Commands

Commands recognized by SE2L are described in this section. SE2L will respond with the corresponding data when it receives these commands. Format should be strictly followed in order to obtain the appropriate data. SE2L will reply with error status (refer to section 7) if length, CRC or header string validation fails.

SE2L performs communication routine once in every sensing cycle (one sensing cycle of SE2L is 29 to 30ms) and sends the reply to any command received during this period. Therefore, if commands are not received completely in once cycle it will take another cycle to send the reply. If there is no response message from SE2L and user need to resend the request command, resend the command after a sufficient interval, taking into consideration that SE2L processes communication only once per measurement cycle (approximately 30ms). Avoid continuously sending the commands to SE2L without waiting for the reply. It will affect the performance and becomes a cause of error.

Some of the commands can set SE2L to supply the measurement data continuously. When SE2L is in continuous transmission mode, it will supply the data at every 30ms (approx.). Continuous mode can be terminated by sending the appropriate stop commands. In continuous transmission mode, avoid sending additional commands to acquire the same data. However, commands to request other information such as, sensor version can be sent to SE2L.



When the scan skip function is active, device will reply only during the measurement cycles. For example, if the scan skip function is configured as 2, reply of AR02, AR04, and AR07 (refer to sections 6.2.3 and 6.2.4, 6.2.8) commands will be provided at every 90msec. However, if the device is in the error state, the reply will be sent at every cycle. In such case, the values of measurement data when the sensor is skipping the measurement will be 0xFFFF. Further, scan skip function is temporarily suspended when the device is in setting mode and the communication cycle is 30msec.

## 6.1 Version Details (VR Command)

When SE2L receives this command, it replies with its version details. In this reply message, the sensor model, firmware version and serial number are character data and are transmitted as ASCII characters.

Before acquiring sensing data using AR commands, send the VR command to confirm the connection with intended SE2L.

### Host»SE2L

STX 1 char	Length 4 char	V 1 char	R 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

### Host«SE2L

STX 1 char	Length 4 char	V 1 char	R 1 char	0 1 char	0 1 char	Status 2 char
Sensor model <sup>1</sup> 29 char	,					
Firmware version <sup>1</sup> 29 char	,					
Reserved 29 char	,	Reserved 2 char	,	Reserved 4 char	,	
Serial Number n <sup>2</sup> char	,	CRC 4 char	ETX 1 char			

Total Size: 115+n char

<sup>1</sup>1 If the content is 29 characters or less, the remaining characters will be filled with spaces (ASCII code 0x20).

<sup>2</sup>2 Length of the serial number can be 8 to 16 ascii characters

## 6.2 Sensing Data (AR Commands)

There are 9 variations of this command differentiated by sub-header. Function of commands will vary depending on it (Table 6.2.1). When SE2L receives this command, it replies with its sensing data (Table 6.2.2).

After sending a command to acquire data in continuous transmission mode, avoid sending additional commands to get the same data. However, commands to request other information such as, sensor version, can be sent to SE2L even in continuous mode.

SE2L will supply the data at every 30ms (approx.) in continuous transmission mode. Even if SE2L can not perform the measurement due to internal error or goes to lockout state, it will continue to send the reply but the measurement values are not updated.



Before acquiring sensing data using AR commands, send the VR command to check the serial number for verifying the connection with an intended SE2L.

Table 6.2.1: Function of AR Commands Based on Sub-header Parameter

Command	Function
“AR00”	Acquire sensing data with measured distance
“AR01”	Acquire sensing data with measured distance and intensity
“AR02”	Acquire sensing data with measured distance in continuous mode
“AR03”	Stop continuous mode initiated by “AR02”
“AR04”	Acquire sensing data with measured distance and intensity in continuous mode
“AR05”	Stop continuous mode initiated by “AR04”
“AR06”	Acquire sensing data with high resolution measured distance
“AR07”	Acquire sensing data with high resolution measured distance in continuous mode
“AR08”	Stop continuous mode initiated by “AR07”

Table 6.2.2: Details of Sensing Data

Item	Data	Remarks
Operating Mode	0: Normal 1: Setting	
Area Number	00 to 7F	Offset the number by 1 to match with 7-seg display of SE2L
Error State	0: No error 1: Error is detected	Use this information with Error Code to show the error status. Also check the Lockout State.
Error Code	1 to BF	Use this information with Error Status to show the error number. Offset the number by 0x40 to match with 7-seg display of SE2L. Refer to SE2L user's manual for error details.
Lockout State	0: Normal 1: Lockout	Use this information with Error Code to show the error status. Also check the Error State.
OSSD 1 State	0: Off (No detection) 1: On (Detection)	Always 1 in setting mode
OSSD 2 Status	0: Off (No detection) 1: On (Detection)	Always 1 in setting mode
Warning 1 State	0: Off (No detection) 1: On (Detection)	Always 0 when SE2L is operating without warning zone1. Always 1 in setting mode when operating with warning zone1.
Warning 2 State	0: Off (No detection) 1: On (Detection)	Always 0 when SE2L is operating without warning zone2. Always 1 in setting mode when operating with warning zone2.
OSSD 3 State	0: Off (No detection) 1: On (Detection)	Always 0 when SE2L is operating without protection zone2. Always 1 in setting mode when operating with protection zone2.
OSSD 4 State	0: Off (No detection) 1: On (Detection)	Always 0 when SE2L is operating without protection zone2. Always 1 in setting mode when operating with protection zone2.
Muting/override State1	0: Not Active 1: Active	Always 0 when SE2L is operating without muting function.
Muting/override State2	0: Not Active 1: Active	Always 0 when SE2L is operating without muting function and/or without protection zone2.
Reset Request1	0: Off 1: On	Always 0 when SE2L is operating without interlock1 function.
Reset Request2	0: Off 1: On	Always 0 when SE2L is operating without interlock2 function and/or without protection zone2.
Encoder Speed	0 to FFFF	Always 0 when SE2L is operating without encoder Input function.
Time Stamp	0 to FFFFFFFF	Unit is millisecond.
Laser off State	0: Laser is emitted 1: Laser is stopped	Always 0 when operating without Laser off function Always 0 in setting mode
Optical Window Contamination Warning	0: Off (Not contaminated) 1: On (Contaminated)	Data will be 1 when optical window starts to accumulate dust. Use this information to clean the optical window before it becomes severe leading the device to error state (error 85, b1 to c1).
Encoder Input Pattern Number«	0 to 7	Always 0 when operating without encoder input function.
Encoder Angle Velocity	0000 to FFFF	Encoder angle velocity. Always 0 when angular velocity function is not used.
Reserved	0	-
Protection Zone1 Detection Start Step	0000 to 0870 FFFF	First step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Protection Zone1 Detection End Step	0000 to 0870 FFFF	Last step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Protection Zone2 Detection Start Step	0000 to 0870 FFFF	First step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Protection Zone2 Detection End Step	0000 to 0870 FFFF	Last step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Warning Zone1 Detection Start Step	0000 to 0870 FFFF	First step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Warning Zone1 Detection End Step	0000 to 0870 FFFF	Last step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Warning Zone2 Detection Start Step	0000 to 0870 FFFF	First step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Warning Zone2 Detection End Step	0000 to 0870 FFFF	Last step number where the obstacle is detected (0 to 1081). No obstacle is detected.
Distance Data	0000 to FFFF	1081 Steps data Note: 1. Values more than 40000 are error code (0xFFFF). 2. If object is not detected value will be 65534 (0xFFFFE). 3. If object is at a very close range value will be 65533 (0xFFFFD). 4. When the device is in laser off state the value will be 65532 (0xFFFFC)

Item	Data	Remarks
Distance Data – High resolution	0000 to FFFF	2161 Steps data Note: 1. Values more than 40000 are error code (0xFFFF). 2. If object is not detected value will be 65534 (0xFFFFE). 3. If object is at a very close range value will be 65533 (0xFFFFD). 4. When the device is in laser off state the value will be 65532 (0xFFFFC)
Intensity Data	0000 to FFFF	1081 Steps data Note: 1. If object is not detected the value will be 0. 2. Do not use the value if distance of the corresponding step has error. 3. When the device is in laser off state the value will be 65532 (0xFFFFC).

### 6.2.1 AR00 Command

When SE2L receives this command, it provides sensing data with measured distance. Refer to Table 6.2.2 for details on the data.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	0 1 char	Status 2 char	
Operating Mode 1 char	Area Number 2 char		Error Status 1 char		Error Code 2 char		Lockout State 1 char
OSSD 1 State 1 char	OSSD 2 State 1 char		Warning 1 State 1 char		Warning 2 State 1 char		
OSSD 3 State 1 char	OSSD 4 State 1 char		Reserved (0) 1 char		Reserved (0) 1 char		
Muting/Override State 1 1 char	Muting/Override State 2 1 char						
Reset Request 1 1 char	Reset Request 2 1 char		Encoder Speed 4 char				
Time Stamp 8 char	Laser off State 1 char		Optical Window Contamination Warning 1 char		Encoder Input Pattern Number 1 char	Reserved (0) 5 char	
Encoder Angle Velocity 4 char	Reserved (0) 1 char						
Protection Zone1 Detection Start Step 4 char	Protection Zone1 Detection End Step 4 char		Protection Zone2 Detection Start Step 4char		Protection Zone2 Detection End Step 4char		
Warning Zone1 Detection Start Step 4 char	Warning Zone1 Detection End Step 4 char		Warning Zone2 Detection Start Step 4char		Warning Zone2 Detection End Step 4char		
Distance Data 4324 char	CRC 4 char	ETX 1 char					

Total Size: 4411 char

### 6.2.2 AR01 Command

When SE2L receives this command, it provides sensing data with measured distance and intensity. Refer to Table 6.2.2 for details on the data.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	1 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	1 1 char		
Same as AR00 Command							
Intensity Data 4324 char		CRC 4 char	ETX 1 char				

Total Size: 8735 char

### 6.2.3 AR02 Command

When SE2L receives this command, it provides sensing data with measured distance in continuous mode. Data is supplied at every 30ms (approx.) after completing the scan. Send “AR03 Command” (refer to section 6.2.4) to stop the continuous data output.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	2 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

- First response of SE2L (contains only the status without any data)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	2 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

- Scan data response of SE2L (provides the same data as in “AR00 command” (refer to section 6.2.1) with continuous mode)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	2 1 char			
Same as AR00 Command								
CRC 4 char	ETX 1 char							

Total Size: 4411 char

### 6.2.4 AR03 Command

SE2L stops the continuous data output initiated by “AR02 Command” (refer to section 6.2.3) on receiving this command.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	3 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	3 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

### 6.2.5 AR04 Command

When SE2L receives this command, it provides sensing data with measured distance and intensity in continuous mode. Data is supplied at every 30ms (approx.) after completing the scan. Send “AR04 Command” (refer to section 6.2.6) to stop the continuous data output.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	4 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

- First response of SE2L (contains only the status without any data)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	4 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

- Scan data response of SE2L (provides the same data as in “AR01 command” (refer to section 6.2.2) with continuous mode)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	4 1 char			
Same as AR01 Command								
CRC 4 char	ETX 1 char							

Total Size: 4411 char

### 6.2.6 AR05 Command

SE2L stops the continuous data output initiated by “AR04 Command” (refer to section 6.2.5) on receiving this command.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	5 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	5 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

### 6.2.7 AR06 Command

When SE2L receives this command it provides data with high resolution measured distance. Refer to Table 6.2.2 for details on the data.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	6 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	6 1 char		
Same as AR00 Command							
Distance Data-High Resolution 8644 char			CRC 4 char	ETX 1 char			

Total Size: 8731 char

### 6.2.8 AR07 Command

When SE2L receives this command, it provides sensing data with high definition measured distance in continuous mode. Data is supplied at every 30ms (approx.) after completing the scan. Send “AR08 Command” (refer to section 6.2.6) to stop the continuous data output.

#### Host»SE2L

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	7 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

- First response of SE2L (contains only the status without any data)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	7 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

- Scan data response of SE2L (provides the same data as in “AR06 command” (refer to section 6.2.7) with continuous mode)

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	7 1 char			
Same as AR06 Command								
CRC 4 char	ETX 1 char							

Total Size: 8731 char

### 6.2.9 AR08 Command

SE2L stops the continuous data output initiated by “AR07 Command” (refer to section 6.2.5) on receiving this command.

**Host»SE2L**

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	8 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

**Host«SE2L**

STX 1 char	Length 4 char	A 1 char	R 1 char	0 1 char	8 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

### 6.3 Status Data (XR Commands)

When SE2L receives this command, it provides the status data. Refer to Table 6.2.2 for details on the data.

#### Host»SE2L

STX 1 char	Length 4 char	X 1 char	R 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	X 1 char	R 1 char	0 1 char	0 1 char	Status 2 char	
Operating Mode 1 char	Area Number 2 char		Error Status 1 char		Error Code 2 char		Lockout State 1 char
OSSD1 State 1 char	OSSD2 State 1 char		Warning1 State 1 char		Warning2 State 1 char		
OSSD3 State 1 char	OSSD4 State 1 char		Reserved (0) 1 char		Reserved (0) 1 char		
Muting/Override State1 1 char	Muting/Override State2 1 char						
Reset Request1 1 char	Reset Request2 1 char		Encoder Speed 4 char		Laser off State 1 char		
Slave1 OSSD1,2 State 1 char	Slave2 OSSD1,2 State 1 char		Slave3 OSSD1,2 State 1 char				
Slave1 OSSD3,4 State 1 char	Slave2 OSSD3,4 State2 1 char		Slave3 OSSD3,4 State2 1 char				
Slave1 Warning1 State 1 char	Slave2 Warning1 State 1 char		Slave3 Warning1 State 1 char				
Slave1 Warning2 State 1 char	Slave2 Warning2 State 1 char		Slave3 Warning2 State 1 char				
Slave1 Error State 1 char	Slave2 Error State 1 char		Slave3 Error State 1 char				
Slave1 Laser off State 1 char	Slave2 Laser off State 1 char		Slave3 Laser off State 1 char				
Time Stamp 8 char	Optical Window Contamination Warning 1 char		Encoder Input Pattern Number 1 char		Encoder Angle Velocity 4 char		
Reserved 34 char	CRC 4 char	ETX 1 char					

Total Size: 106 char

	<ul style="list-style-type: none"> <li>Slave status data are obtained only when the device is configured to operate in master-slave mode.</li> <li>When the command is transmitted to master device, status of the master will be provided on the first part of the reply followed by the status of the slaves in the second part.</li> <li>When the command is transmitted to slave device, its own status will be provided on the first part of the reply and second part will be all 0.</li> </ul>
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## 6.4 Area Data (YR Commands)

When SE2L receives this command, it provides the area configuration data. Refer to Table 6.4.1 for details on the parameters to be provided on the command. Parameters should be sent in the hexadecimal equivalent characters. Status codes for YR command are shown in Table 7.2.

Table 6.4.1 Parameter details in YR command

Parameter	Size	Details	Note
Area type	2	00: Protection Zone 1 01: Protection Zone 2 02: Warning Zone 1 03: Warning Zone 2 04: Muting Area 1 05: Muting Area 2 06: Reference Area (Centre) 07: Reference Area (Max value) 08: Reference Area (Min Value)	Device should be configured with the corresponding function to obtain the correct data.
Area number	2	00: Area 1 01: Area 2 ... ... 7F: Area 128	Provide the area numbers in hexadecimal equivalent characters (0 to 1F). Area number should not exceed the configured active area count.
Start Step	4	0000: Step 0 0001: Step 1 ... ... 0438: Step 1080	- Provide the step values in hexadecimal equivalent characters - Step values should not exceed the maximum range 0438 (1081 in decimal). - Start step should not be greater than the end step. - Start and End Step of protection and warning areas will change with the active area configuration as follows, Active area up to 32: 0 to 1081 Active area up to 64: 0 to 541 Active area up to 128: 0 to 271
End Step	4	0000: Step 0 0001: Step 1 ... ... 0438: Step 1080	
Grouping	2	00/01: No grouping 02: Grouping two data 03: Group three data ... ... 09: Group nine data	Parameter 00 and 01 are treated in the same way (no grouping). Steps with the specified count are treated as one group and a single value is supplied from each group in order to reduce the data volume. Data with the maximum value in the group is provided when the grouping is more than 2.
Area Data	4n	0 to 7FFF (15 bit data)	Uppermost bit of the area data is reserved. If the data exceeds 7FFF, ignore the first bit and only use the remaining 15 bit data.

### Host»SE2L

STX 1 char	Length 4 char	Y 1 char	R 1 char	Area Type 2 char	Area Number 2 char
Start Step 4 char	End Step 4 char	Grouping 2 char	CRC 4 char	ETX 1 char	

Total Size: 26 char

### Host«SE2L

STX 1 char	Length 4 char	Y 1 char	R 1 char	Area Type 2 char	Area Number 2 char
Start Step 4 char	End Step 4 char	Grouping 2 char	CRC 4 char	ETX 1 char	
Area Data 4n <sup>1</sup> char	CRC 4 char	ETX 1 char			

Total Size: 31+4n char

<sup>1</sup>n=(End Step-Start Step+1)/Resolution

If n is not a whole number, one data from the remaining steps will be supplied.

## 6.5 Detection Log Command

When SE2L detects obstacle in the protection area it records the information such as, operating area number, distance and step (position) of the obstacle. If obstacles are present at multiple steps, SE2L records the data of the step having the shortest range. In master-slave mode, master unit records the detection log of all the slaves however, slave units don't record the master or other slave's detection information. There are two commands related to detection log function, one to obtain the log and the other to clear it.

### 6.5.1 Detection Log Read (DL00 Command)

When SE2L receives this command, it provides detection log data. SE2L stores maximum 29 sets of log information in a ring buffer in its RAM. Contents of the log data is given in Table 6.5.1.1. When log count exceeds 29, old records are overwritten by the new ones in the ring buffer. A set of log data is 64 characters long (Figure 6.5.1.1). Value "FFFF" of the first 4 data, indicates the end position of the ring buffer therefore, ignore the 64 characters in this line. Data above the indicator are new and below it are the old logs. Since the data are stored in the RAM, they are erased whenever the device is switched off.

Table 6.5.1.1 Details of Detection Log

Item	Date	Remarks
Input/Output*1	0 to FFFF	<p>Input and output states of the connected device.          Bit15 to Bit8 represents the operating area number when the log was recorded.          Value is from 0x00 to 0x1F which represents area 1 to area 32.          Bit1 represents detection state of Protection zone1.          Bit0 represents detection state of Protection zone2.</p> <p>Note:</p> <ol style="list-style-type: none"> <li>1. Value FFFF of this data indicates the end position of the ring buffer therefore, ignore 64 characters in this set. Data above the indicator are new and below it are the old logs (Figure 6.5.1.1).</li> <li>2. Bit 0 is always 0 when SE2L is operating without protection zone2.</li> </ol>
Protection1 Min dist	0 to FFFF	Minimum distance measured inside the protection zone1.
Protection1 Min dist step	0 to FFFF	<p>Position where the minimum distance was detected inside the protection zone1.          Note:          Data is provided in high resolution (0.125°/step) step number (0 to 2160). Divide the number by 2 to match with lower resolution (0.25°/step) step number (0 to 1080).</p>
Protection2 Min dist	0 to FFFF	<p>Minimum distance measured inside the protection zone2.          Note:          Always 0 when SE2L is operating without protection zone2.</p>
Protection2 Min dist step	0 to FFFF	<p>Position where the minimum distance was detected inside the protection zone2.          Note:  <ol style="list-style-type: none"> <li>1. Data is provided in high resolution (0.125°/step) step number (0 to 2160). Divide the number by 2 to match with lower resolution (0.25°/step) step number (0 to 1080).</li> <li>2. Always 0 when SE2L is operating without protection zone2.</li> </ol> </p>
Slave1 Input/Output	0 to FFFF	<p>If SE2L is operating in Master-Slave mode and connected unit is Master, this is an input and output states of Slave unit 1.          Note:  <ol style="list-style-type: none"> <li>1. Details are same as input output states (see *1) of connected device.</li> <li>2. Always 0 when the device is slave unit.</li> </ol> </p>
Slave2 Input/Output	0 to FFFF	<p>If SE2L is operating in Master-Slave mode and connected unit is Master, this is an input and output states Slave unit 2.          Note:  <ol style="list-style-type: none"> <li>1. Details are same as input output states (see *1) of connected device.</li> <li>2. Always 0 when the device is slave unit.</li> </ol> </p>
Slave3 Input/Output	0 to FFFF	<p>If SE2L is operating in Master-Slave mode and connected unit is Master, this is an input and output states Slave unit 3.          Note:  <ol style="list-style-type: none"> <li>1. Details are same as input output states (see *1) of connected device.</li> <li>2. Always 0 when the device is slave unit.</li> </ol> </p>
Log Lapsed time	0 to FFFFFFFF	<p>It is the duration that has lapsed since the data was recorded and the log command was received. Unit is second.          For example, if the value is 0000007A, then the log was recorded 122 seconds ago.</p>
Reserved	0 to FFFF	Note: Ignore the data.

Host»SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

Host<SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	0 1 char	Status 2 char
Log Data 1920 char	CRC 4 char	ETX 1 char				

Total Size: 1936 char

### Log details:

Log details				
Log1	Input /Output*1 4 char	Protection1 Min dist. 4 char	Protection1 Min dist step 4 char	Protection2 Min dist. 4 char
	Slave1 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	
	Slave2 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	
	Slave3 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	Log lapsed time 8 char
...			...	
...			...	
Log30	Input /Output 4 char	Protection1 Min dist. 4 char	Protection1 Min dist step 4 char	Protection2 Min dist. 4 char
	Slave1 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	
	Slave2 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	
	Slave3 Input /Output*1 4 char	Reserved 4 char	Reserved 4 char	Log lapsed time 8 char

\*1 Input/Output bit details:

15	14	13	12	11	10	9	8	7	6	5	4	3	2		1		0
Area number					Reserved					Protection1 state			Protection2 state				

Figure 6.5.1.1 Example of log data obtained from SE2L

### 6.5.2 Detection Log Clear (DC00 Command)

When SE2L receives this command, it clears detection log data stored in its RAM. Since the data are stored in the RAM, they are automatically erased whenever the device is switched off.

#### Host»SE2L

STX 1 char	Length 4 char	D 1 char	C 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	D 1 char	C 1 char	0 1 char	0 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

### 6.5.3 Detection Log Read(DL01/DL02 Command)

When SE2L receives DL01/DL02 command, it provides detection log data. SE2L stores maximum 29 sets of log information in a ring buffer in its RAM, however, when SE2L receives DL01 command, it sends the first 15 sets of log information and the remaining 15 sets are sent when it receives DL02 command. Before processing, it is necessary to merge the data received by both commands.

Contents of the log data is given in Table 6.5.1.1. When log count exceeds 29, old records are overwritten by the new ones in the ring buffer. A set of log data is 64 characters long (Figure 6.5.1.1). Value “FFFF” of the first 4 data, indicates the end position of the ring buffer therefore, ignore the 64 characters in this line. Data above the indicator are new and below it are the old logs. Since the data are stored in the RAM, they are erased whenever the device is switched off.

#### Host»SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	1 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	1 1 char	Status 2 char
Log Data 960 char	CRC 4 char	ETX 1 char				

Total Size: 976 char

#### Host»SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	2 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

#### Host«SE2L

STX 1 char	Length 4 char	D 1 char	L 1 char	0 1 char	2 1 char	Status 2 char
Log Data 960 char	CRC 4 char	ETX 1 char				

Total Size: 976 char

## 6.6 Configuration ID (ID Command)

This is a command to read the 32-bit configuration ID of the setting data stored in the device. It is calculated and saved in the device during the device configuration. The value will be 0 if the device is not configured or the settings are initialized.

### Host»SE2L

STX 1 char	Length 4 char	1 1 char	D 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

### Host«SE2L

STX 1 char	Length 4 char	1 1 char	D 1 char	0 1 char	0 1 char	Status 2 char	
Configuration ID1 <sup>*1</sup> 8 char	Configuration ID1 <sup>*2</sup> 8 char			CRC 4 char	ETX 1 char		

Total Size: 32 char

\*1 ID with date and IP settings. Value will be 0 when device is not configured or initialized.

\*2 ID without date and IP settings. Value will be 0 when device is not configured or initialized.

## 6.7 Reboot Device (SB Command)

This is a command to reboot the device. This command is accepted only when the device is in error state. There must be 2 consecutive RB command within 1sec for the device to reboot. The sensor will restart after approximately 1 sec on receiving the second command.

### Host»SE2L

STX 1 char	Length 4 char	S 1 char	B 1 char	0 1 char	0 1 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	---------------	---------------

Total Size: 14 char

### Host«SE2L

STX 1 char	Length 4 char	S 1 char	B 1 char	0 1 char	0 1 char	Status 2 char	CRC 4 char	ETX 1 char
---------------	------------------	-------------	-------------	-------------	-------------	------------------	---------------	---------------

Total Size: 16 char

# Chapter 7 Reply Status

SE2L validates the received command by conducting number of checks. If they are successful SE2L replies with the corresponding data with the status code “00”. On the other hand, it will reply with error status if verification fails. Details of status codes are shown in table 7.1.

Table 7.1 Detail of Status Code

Status	Detail
0x00	No error
0x12	Received command does not contain the minimum required fields or received data size exceeds the maximum size of internal buffer.
0x31	Command is received without STX.
0x34	Command header contains unspecified characters.
0x35	Data contains unspecified characters.
0x36	Data size is not equal to the size mentioned in the command.
0x37	CRC of received data is not equal to CRC in the command.
0x41, 0x42	Unspecified command is received.
0x44	Sub header is out-of-range.
0x45	Sub header is not a number.
0x66	Configuration of SE2L is incomplete.
0x73	Unable to process commands (AR02 and AR04) as the device is in setting mode. (Continuous data output mode can not be started when the device is in setting mode).
Others	Internal error (See table 7.2 if the transmitted command is status command YR)

Table 7.2 Detail of Status Code for YR command

Status	Detail
0x00	No error
0x44	<ul style="list-style-type: none"><li>• Grouping count exceed the maximum value.</li><li>• Area type exceeds the maximum value.</li></ul>
0x52	<ul style="list-style-type: none"><li>• Start and/or end step exceeds the maximum value.</li><li>• Start step is greater than end step.</li></ul>
0x54	Area number exceeds the maximum value.
0x55	Area number exceeds the active area count in the sensor.
0x81	Protection2 data is requested (YR01) without activating the Protection2 area.
0x82	Warning1 data is requested (YR02) without activating the Warning1 area.
0x83	Warning2 data is requested (YR03) without activating the Warning2 area.
0x84	Muting1 data is requested (YR04) without activating the muting1 area.
0x85	Muting2 data is requested (YR05) without activating the muting2 area.
0x86	Reference data is requested (YR06) without activating the reference area.
0x87	Reference max data is requested (YR07) without activating the reference area.
0x88	Reference min data is requested (YR08) without activating the reference area.



When the scan skip function is active, device will reply only during the measurement cycles. For example, if the scan skip function is configured as 2, reply of commands will be provided at every 90ms. However, if the device is in the error state, the reply will be sent at every cycle. In such case, the values of measurement data when the sensor is skipping the measurement will be 0xFFFF. Further, scan skip function is temporarily suspended when the device is in setting mode and the communication cycle is 30ms.

# Chapter 8 Protocol Mode Communication

List of supported B Protocol commands are shown in Table 8.1.

Table 8.1 B Protocol Commands

Command	Function
BM	Acquire state of the laser
GD	Acquire measured distance
GE	Acquire measured distance and intensity
MD	Acquire measured distance in continuous mode
ME	Acquire measured distance and intensity in continuous mode
QT	Stop the continuous mode
RS	Stop the continuous mode
RT	Stop the continuous mode
VV	Acquire version detail of SE2L
PP	Acquire parameters of SE2L
II	Acquire state of SE2L
RB	Restart SE2L which is in an error state.



If SE2L detects an error and transfers to lockout state while performing continuous mode using MD or ME commands, the continuous mode is stopped.

## 8.1 B Protocol Format

### 8.1.1 Request Message

Request Message is sent from the host computer to SE2L. It contains command code, parameters, user specified strings and request terminator (Figure 8.1.1.1).

Command code is expressed in two upper case alphabets. SE2L uses this code to differentiate the command and provides the corresponding response.

Parameters are command specific values expressed in integers. Values should be filled with zero if integer digits are less than parameter's size, for example, if the value is 4, it must be represented as 4, 04, or 004 respectively if parameter size is one, two, or three. Encoding is not applied for the parameters.

User specified string is sequence of characters starting with a semicolon (Figure 8.1.1.2). Characters that can be used are all the alphabets and numbers along with special characters ' ', '.', '\_', '+', '-' and '@'. Avoid using any other characters in the string and limit the size to maximum 16 characters. User specified string is an optional field therefore it can be excluded from the request message.

However when same request is issued in succession with separate strings it can serve as a means to differentiate the response message from SE2L.

Request terminator can be a Line feed (LF) character, a Carriage Return (CR) character or both CR and LF in succession.

Request message



command code : 2 character code to specify command task.  
parameter : command specific parameters.  
string : user defined string preceded by semicolon.  
RT : request terminator which is either 1 character of CR or LF, or 2 characters with CR and LF in succession.

Figure 8.1.1.1 B Protocol Request Message Format

User string

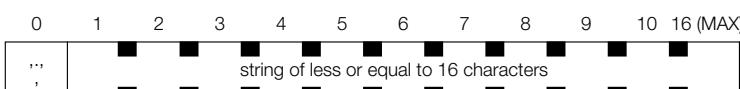


Figure 8.1.1.2 User String Format

## 8.1.2 Response Message

Response Message is sent from SE2L to host computer after receiving a request. It contains echo back of request message, status, check code, data corresponding to the command code and response delimiter (Figure 8.1.2.1).

Echo back is the retransmission of request message by SE2L excluding the request terminator.

Status is a two character alpha-numeric code to inform the success or failure of the command execution.

Check code is a one character code generated for the data enclosed between response delimiter (refer to section 8.3).

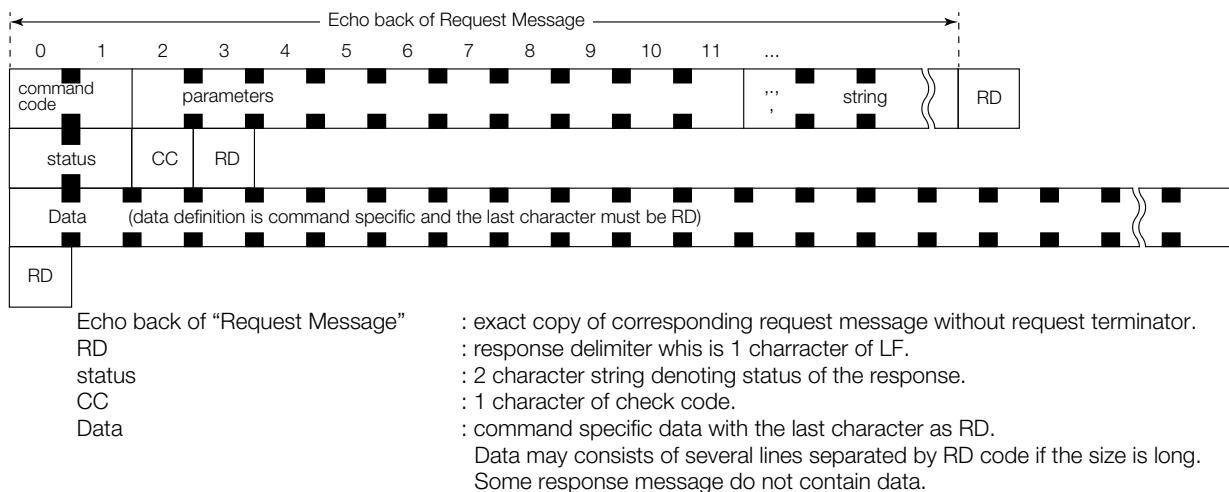
Data is SE2L's internal state or measurement values. Some of the data are encoded before transmission. See the corresponding commands in section 8.7 for the type of data sent by SE2L and encoding applied to them.

Response delimiter is a line feed character inserted between the data and at the end of the response message. Check the two consecutive RD in the response message or empty line to confirm the response termination.



When the scan skip function is active, device will reply only during the measurement cycles. For example, if the scan skip function is configured as 2, reply of commands will be provided at every 90ms. However, if the device is in the error state, the reply will be sent at every cycle. In such case, the values of measurement data when the sensor is skipping the measurement will be 0xFFFFE. Further, scan skip function is temporarily suspended when the device is in setting mode and the communication cycle is 30ms.

### Response message



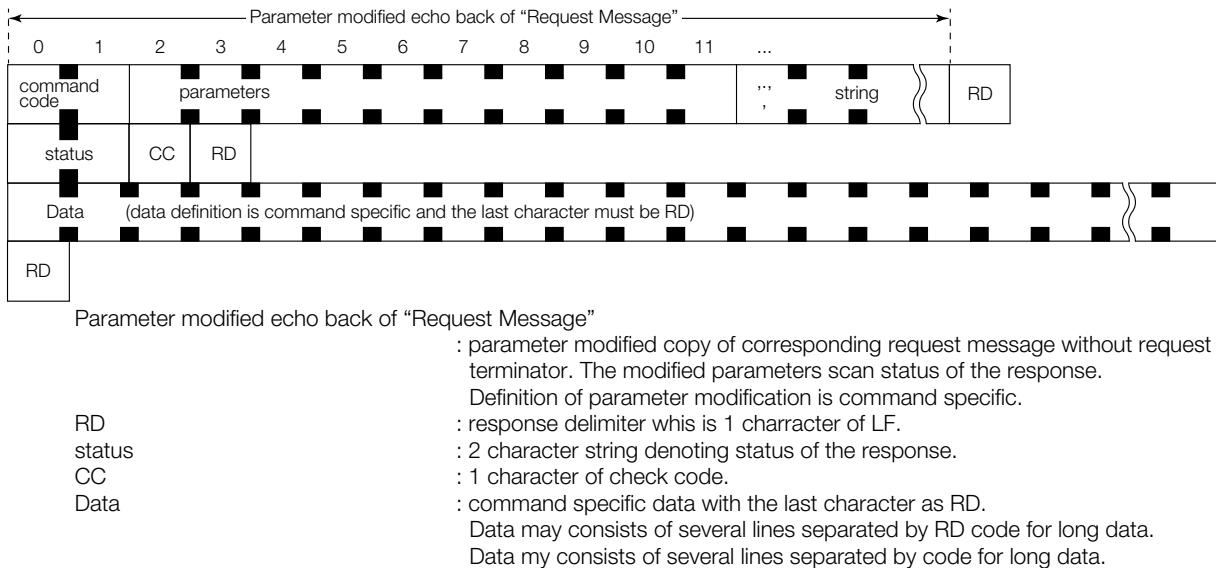
The last RD denotes the termination of response message. However, since RD are also included in the data, it alone can not be used for judging the response message termination. Check for the empty line at the end of a message or two consecutive RD for this purpose. There should not be two consecutive RD in the data.

Figure 8.1.2.1 Response Message Format

### 8.1.3 Scan Response Message

Apart from general response format (refer to section 8.1.2), SE2L provides the data in an additional format called, scan response message, when request message is sent to obtain data in continuous mode (Figure 8.1.3.1). Echo back in such message is not exactly the same as request message. They are partially changed. Further, status of such response reflects the current state of SE2L.

Scan response message



The last RD denotes the termination of response message. However, since RD are also included in the data, it alone can not be used for judging the response message termination. Check for the empty line at the end of a message or two consecutive RD for this purpose. There should not be two consecutive RD in the data.

Figure 8.1.3.1 Scan Response Message Format

### 8.2 B Protocol Encoding and Decoding

B protocol encodes the decimal values into ASCII characters in order to compress the data and reduce the transmission time. Encoding process involve dividing a number into groups of 6 bits. For each 6 bit data, 0x30 is added to convert them into ASCII characters.

Example of encoding 1234 (0x4d2) in B protocol:

Step 1: Expressing the data in binary with incomplete upper bits padded with zero.

1234: 00 0000 0100 1101 0010

Step 2: Separate into three groups with 6 bits each

000000 010011 010010

0x00 0x13 0x12

Step 3: Add 0x30 to convert them into ASCII

0x00+0x30=0x30='0'

0x13+0x30=0x43='C'

0x12+0x30=0x42='B'

Data are encoded to either three or four characters. Host computer should appropriately decode the data before using them. Figure 8.2.1 shows the general expression of encoded data.

Character Encoded Data

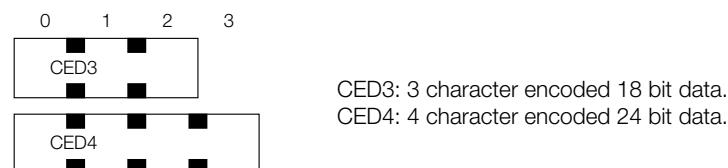


Figure 8.2.1 Representation of Encoded Data

### 8.3 Check Code

Check code is a value obtained by adding all character in a target string. Size of the check code is reduced to 6 bits and applied B Protocol encoding (refer to section 8.2) to convert into ASCII character. Check code should be used for validating the received data by the host computer.

Example of obtaining check code for string "ABC012" in B protocol:

Step 1: Calculate the sum of all characters in the string

'A' 'B' 'C' '0' '1' '2'

0x41+0x42+0x43+0x30+0x31+0x32=0x159

Step 2: Truncate the value to lower 6 bits and add 0x30 to convert into ASCII character.

0x19+0x30=0x49='I'

### 8.4 Timestamp

Timestamp is a 24 bit counter value of internal timer. It is included in the response message of data request commands. 24 bit data is converted into 4 ASCII characters by B Protocol encoding (refer to section 8.2) before transmission. Value will reset to 0 when counter overflows therefore, host computer should handle this with appropriate measure. Timestamp comes as a set with timer value, check code and response delimiter called as, Time Data (Figure 8.4.1).

Time data

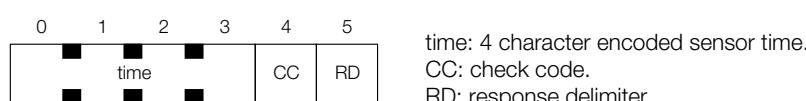


Figure 8.4.1 Representation of Timestamp

## 8.5 Data Splitting

When response message contains a large volume of data they are split into number of blocks each containing 64 characters with its check code and response delimiter (Figure 8.5.1). However, as data may not be always in exact multiple of 64, the last block may contain less than 64 characters with its check code and response delimiter.

Dividing into blocks

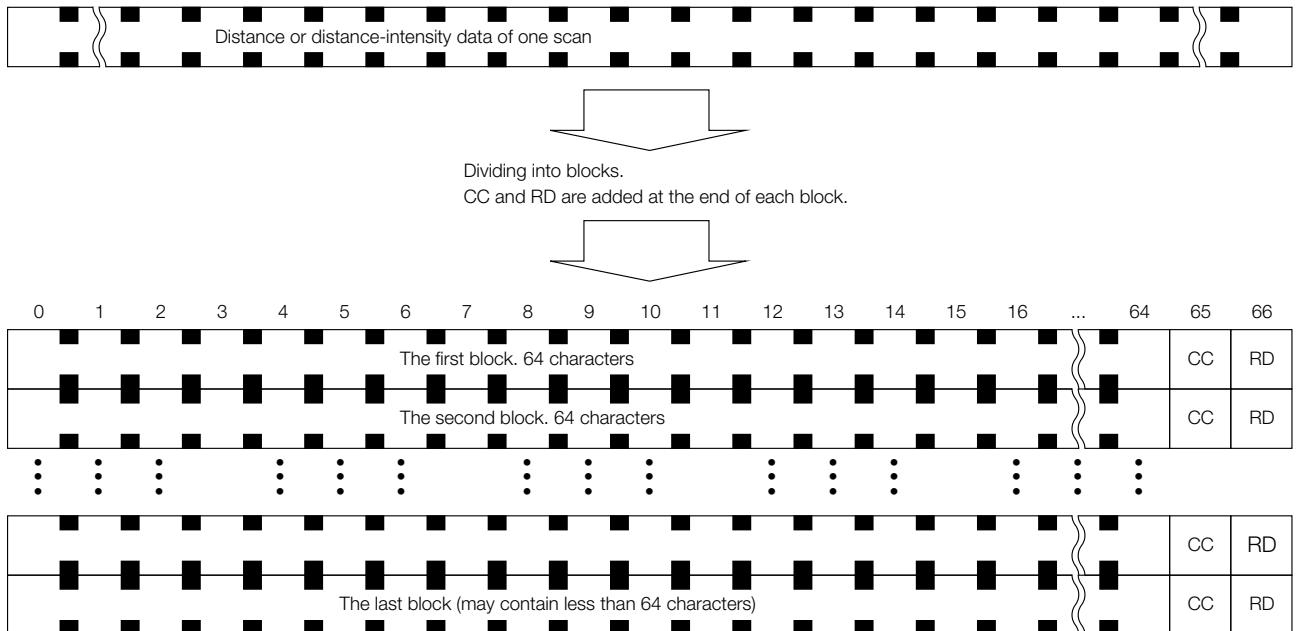


Figure 8.5.1 Separation of Measurement Data into Blocks

## 8.6 Common B Protocol Status Codes

When request message format is wrong or when device is unable to send the desired response due to internal errors, it sends the reply with error status. Status that is common for all commands are shown in Table 8.6.1. Command specific status codes are explained in the respective command in section 8.7.

Table 8.6.1 Common B Protocol Status Codes

Code	Detail
00	No error
01 to 07	Error in the command parameter
0D	Request message is longer than specified
0E	Undefined command
0G	User specified string is longer than allowed
0H	User specified string has error
0N	SE2L is in lockout state due to error

## 8.7 B Protocol Commands

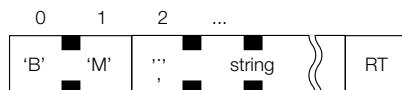
### 8.7.1 BM Command

Request and response messages of BM command are shown in Figure 8.7.1.1 and Table 8.7.1.1 shows the status code detail. Generally the status is always 02, but when the device is in the lockout state due to error or if it is switched to laser off mode, the status will be 01.

Table 8.7.1.1 Details of Status Code

Code	Detail
01	Laser emission is stopped due to internal error or the device is switched to laser off mode >
02	Laser is on

BM request message



BM response message

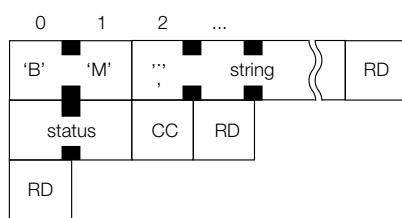


Figure 8.7.1.1 BM command Request and Response

### 8.7.2 Measurement Data (GD and GE Command)

When SE2L receives this command, it replies with measurement data. There are 2 variations of this command. GD Command provides only the distance and GE command provides both the distance and intensity. Parameters in the request message are listed in Table 8.7.2.1. SE2L's response depends on these parameters. Measurement data in the response message are encoded to 3 ASCII characters with B Protocol encoding technique (refer to section 8.2). Further, the data is also split into number of blocks during transmission (refer to section 8.5). Format of request and response message are respectively shown in Figure 8.7.2.1, and 8.7.2.2. If parameters are not received in the correct format, SE2L will send the reply with error status (refer to Table 8.7.2.2). Refer to section 8.1 for details on terminology used in the message.



Before acquiring sensing data using GD, GE command, send the VV command to check the serial number for verifying the connection with an intended SE2L.

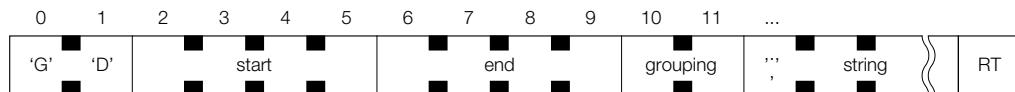
Table 8.7.2.1 Parameters of GD and GE request message

Parameters	Size	Detail	Remarks
Start	4	Position of first measurement data to send	SE2L has a total of 1081 steps (numbered from 0 to 1080). Value should not exceed this range.
End	4	Position of the last measurement data to send	
Grouping	2	Number of adjacent steps among which SE2L is requested to send only the minimum measurement value	Grouping parameter 0 is treated as 1.

Table 8.7.2.2 Details of Status Code

Code	Detail
00	No error
01	Start parameter contains non numeric character
02	End parameter contains non numeric character
03	Grouping parameter contains non numeric character
04	End parameter exceeds the measurement step
05	End parameter is smaller than start parameter
06	Skips parameter contains non numeric character

## GD request message



## GD response message

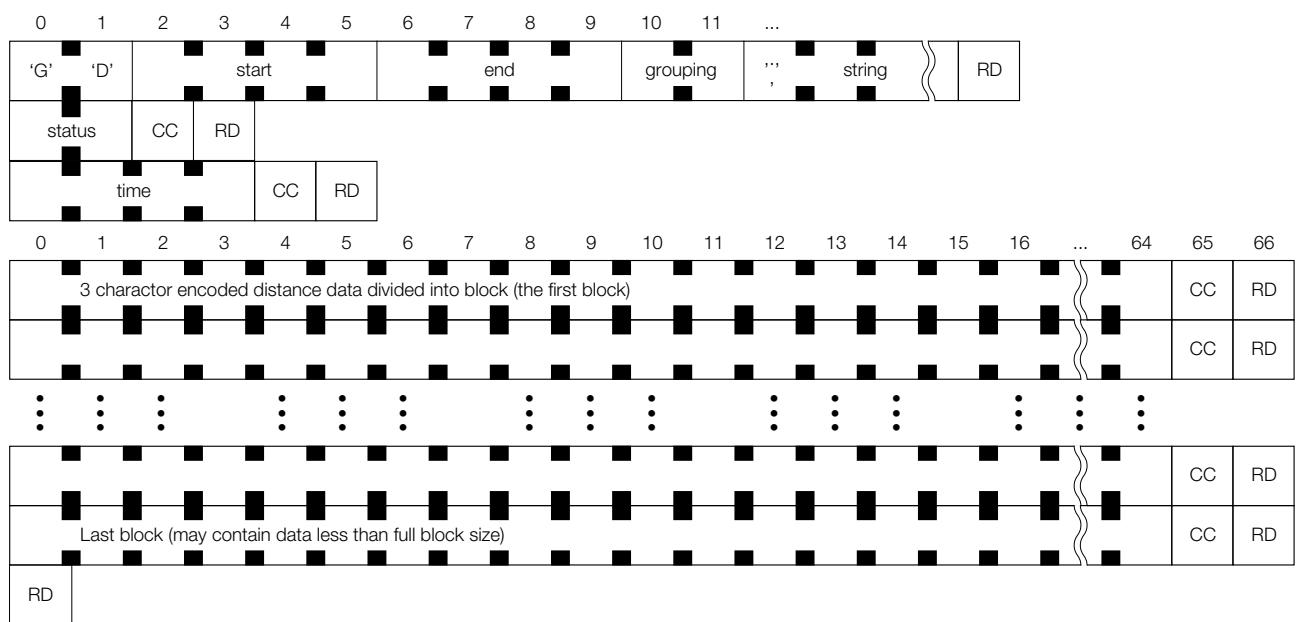
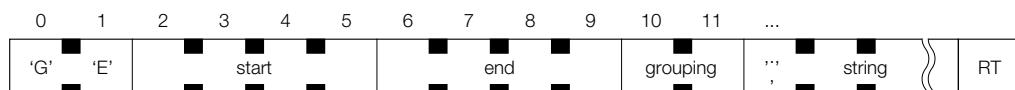


Figure 8.7.2.1 GD command Request and Response

## GE request message



## GE response message

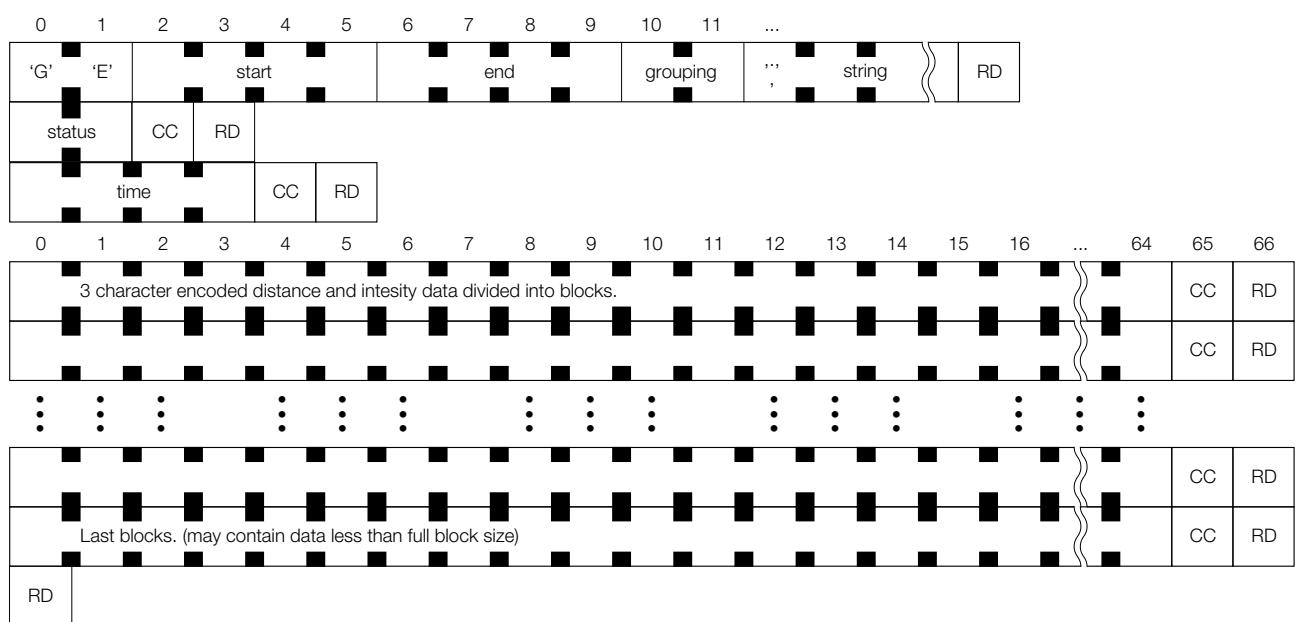


Figure 8.7.2.2 GE command Request and Response

## 8.7.3 Measurement Data (MD and ME Command)

When SE2L receives this command, it replies with measurement data. There are 2 variations of this command. MD Command provides the distance only and ME command provides both the distance and intensity. Parameters in the request message are listed in Table 8.7.3.1. SE2L's response depends on these parameters. Measurement data in the response message are encoded to 3 ASCII characters with B Protocol encoding technique (refer to section 8.2). Further, the data is also split into number of blocks during transmission (refer to section 8.5). Format of request and response message are respectively shown in Figure 8.7.3.1, and 8.7.3.2. If parameters are not received in the correct format, SE2L will send the reply with error status (refer to Table 8.7.3.2). Refer to section 8.1 for details on terminology used in the message.

	<p>Before acquiring sensing data using MD, ME command, send the VV command to check the serial number for verifying the connection with an intended SE2L.</p> <p>Continuous data transmission initiated using the MD, ME command will be terminated if SE2L detects error and goes to lockout state.</p>
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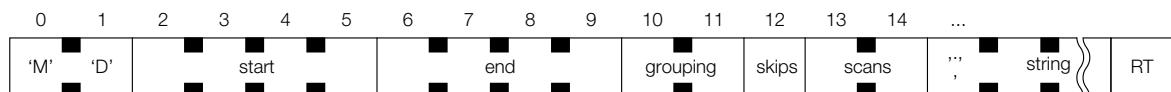
Table 8.7.3.1 Parameters of MD and ME request message

Parameters	Size	Detail	Remarks
Start	4	Position of first measurement data to send	SE2L has a total of 1081 steps (numbered from 0 to 1080). Value should not exceed this range.
End	4	Position of the last measurement data to send	
Grouping	2	Number of adjacent steps among which SE2L is requested to send only the minimum measurement value	Grouping parameter 0 is treated as 1.
Skips	1	Interval to send the data	SE2L skips sending the data for number of cycles provided in this field when it is in continuous transmission mode. One measurement cycle of SE2L is 29 to 30ms.
Scans	2	Number of scan cycles SE2L is requested to provide the data continuously	In the echo back from SE2L, original value in this field is replaced by number of remaining scans. If the parameter is set to "00", SE2L will continue to send the data until it is stopped by sending stop commands. Status in the response message in such case will be "99". Continuous transmission will stop if connection between host computer and SE2L is lost.

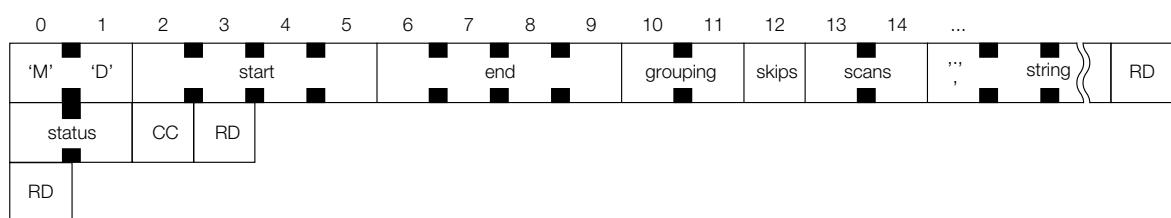
Table 8.7.3.2 Details of Status Code

Code	Detail
00	No error
01	Start parameter contains non numeric character
02	End parameter contains non numeric character
03	Grouping parameter contains non numeric character
04	End parameter exceeds the measurement step
05	End parameter is smaller than start parameter
06	Skips parameter contains non numeric character
07	Scan parameter contains non numeric character

MD request message



MD response message



MD scan response message

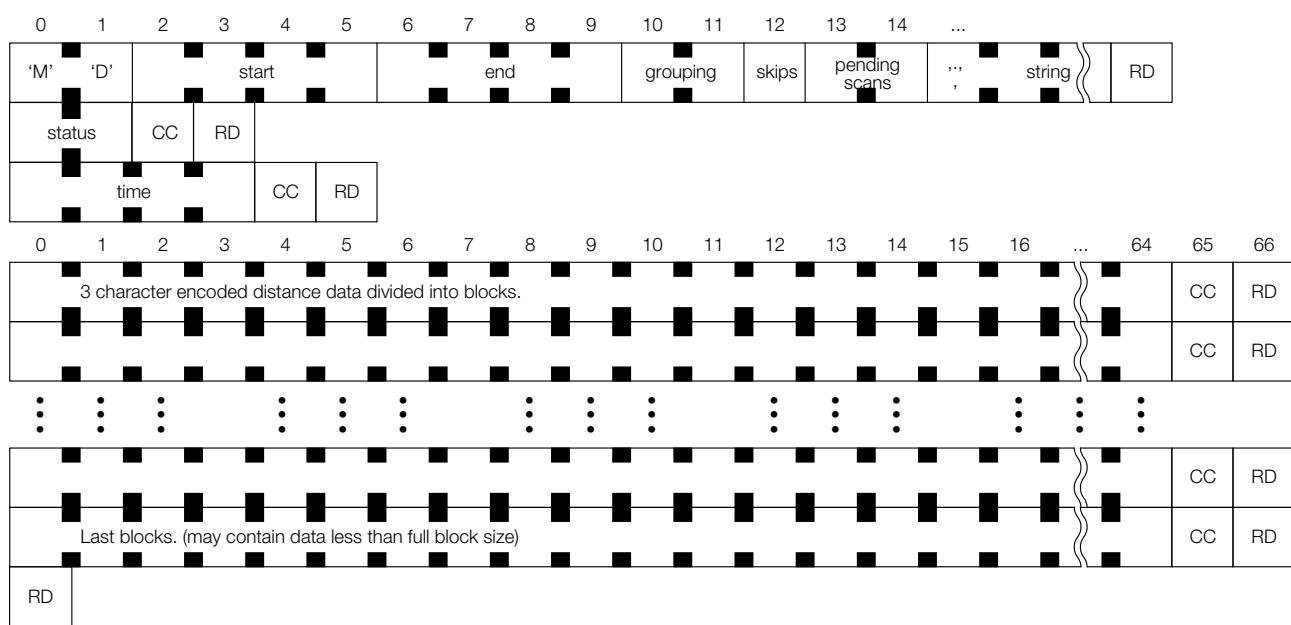
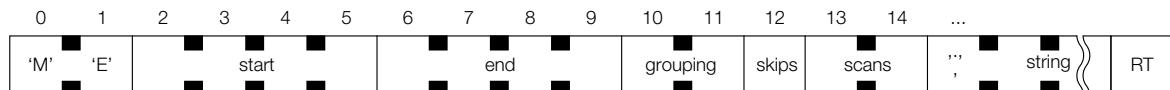
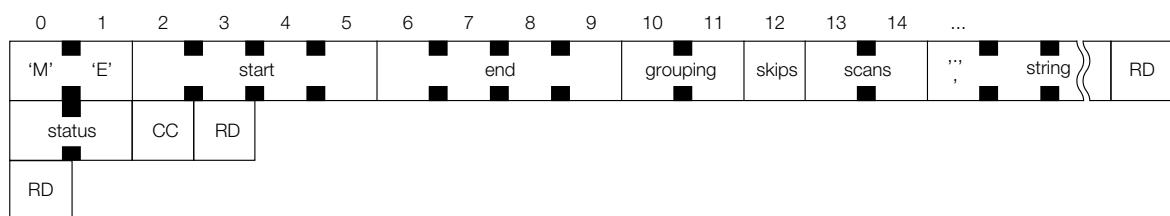


Figure 8.7.3.1 MD command Request and Response

ME request message



ME response message



ME scan response message

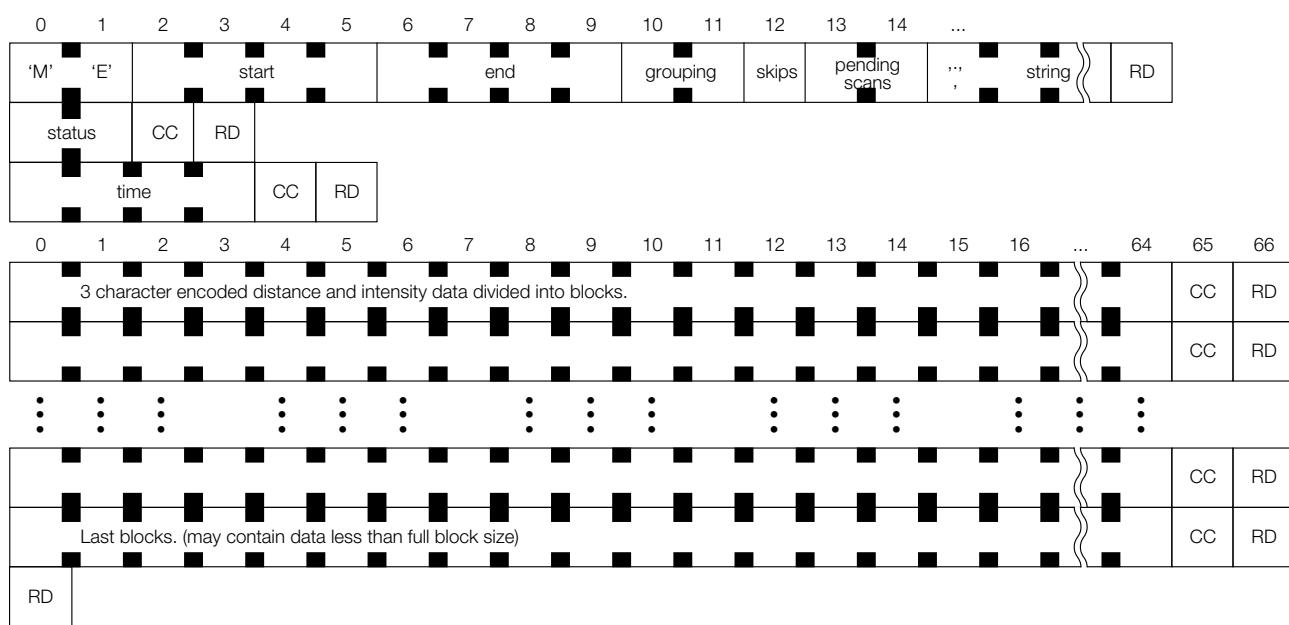


Figure 8.7.3.2 ME command Request and Response

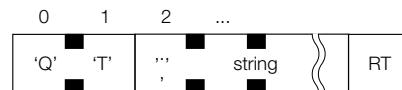
#### 8.7.4 Continuous Transmission Terminate (QT, RS and RT Command)

These commands stop the continuous transmission mode initiated by MD or ME command. Request message has no command specific parameter and response does not contain any data. Format of request and response message are respectively shown in Figure 8.7.4.1, 8.7.4.2 and 8.7.4.3 for QT, RS and RT commands.

Table 8.7.4.1 Details of Status Code

Code	Detail
00	No error. SE2L stops the continuous data transmission

QT request message



QT response message

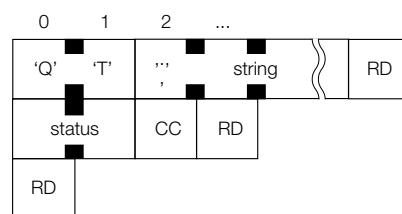
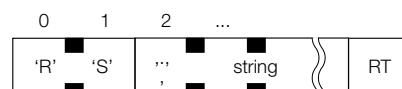


Figure 8.7.4.1 QT command Request and Response

RS request message



RS response message

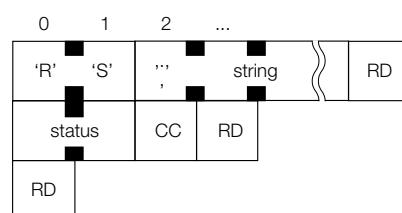
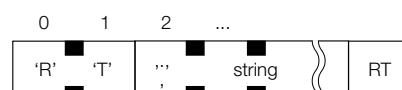


Figure 8.7.4.2 RS command Request and Response

RT request message



RT response message

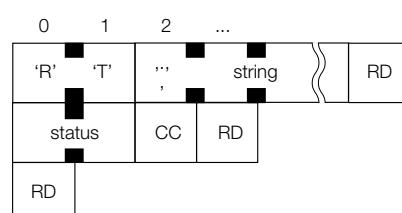


Figure 8.7.4.3 RT command Request and Response

### 8.7.5 Sensor Information (VV, PP and II Commands)

When SE2L receives this command, it replies with sensor information. Request messages have no command specific parameter. Response message contains number of fields separated by a semicolon. Therefore, they should not be treated as a check code. Request and response messages are respectively shown in Figure 8.7.5.1, Figure 8.7.5.2 and Figure 8.7.5.3 for VV, PP and II commands. Information included in response of each command is shown in Table 8.7.5.2, Table 8.7.5.3 and Table 8.7.5.4.

Table 8.7.5.1 Details of Status Code

Code	Detail
00	No error

Table 8.7.5.2 Information in VV Command

Description	String Sample
Vendor information	VEND: IDEC Corporation
Product model	PROD: SE2L-HA05LP
Firmware version	FIRM: 01.01.010
B protocol version	PROT: S 2.0 for Safety
Product serial number	SERI: H0123456

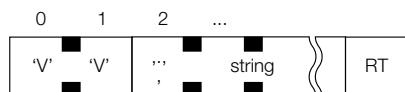
Table 8.7.5.3 Information in PP Command

Description	String Sample
Product model	MODL: SE2L-HA05LP
Minimum measurable distance (mm)	DMIN: 0000
Maximum measurable distance (mm)	DMAX: 40000
Angular resolution (Number of divisions in 360°)	ARES: 1440
First measurement step	AMIN: 0000
Last measurement step	AMAX: 1080
Front measurement step	AFRT: 0540
Standard scanning speed (rpm)	SCAN: 2000

Table 8.7.5.4 Information in II Command

Description	String Sample
Product model	MODL: SE2L-HA05LP
Laser status	LASR: ON
Scanning speed	SCSP: 2000 [rpm]<-Fixed
Sensing mode	MESM: Measuring by Sensitive Mode
Communication speed	SBPS: Ethernet 100 [Mbps]<- Fixed
Time	TIME: 012345
Device status	STAT: Sensor works well.

## VV request message



## VV response message

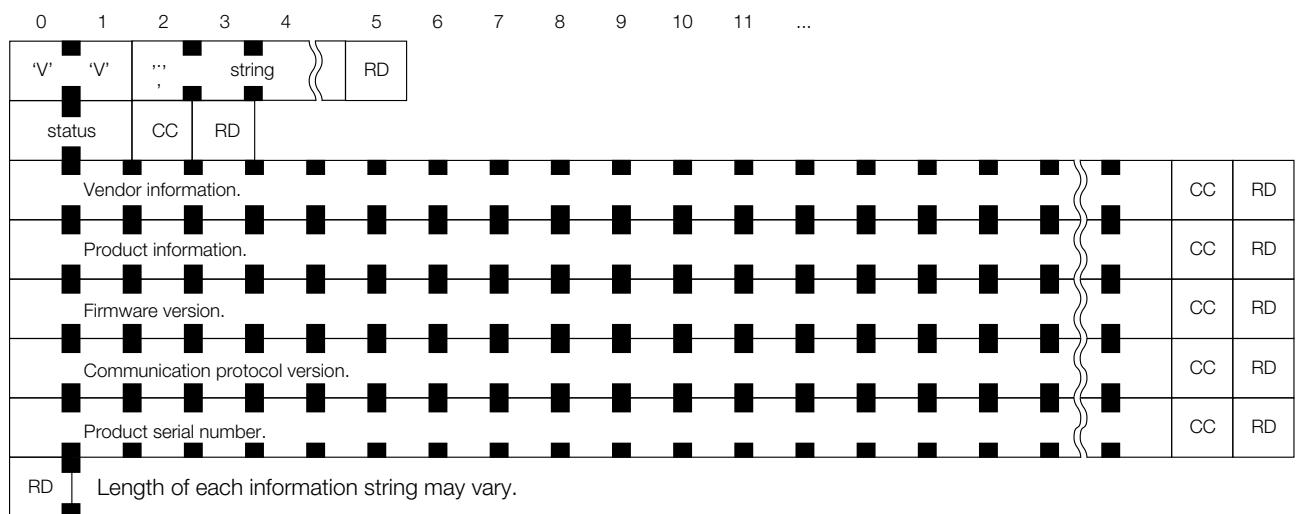
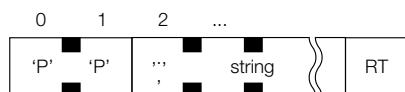


Figure 8.7.5.1 VV command Request and Response

## PP request message



## PP response message

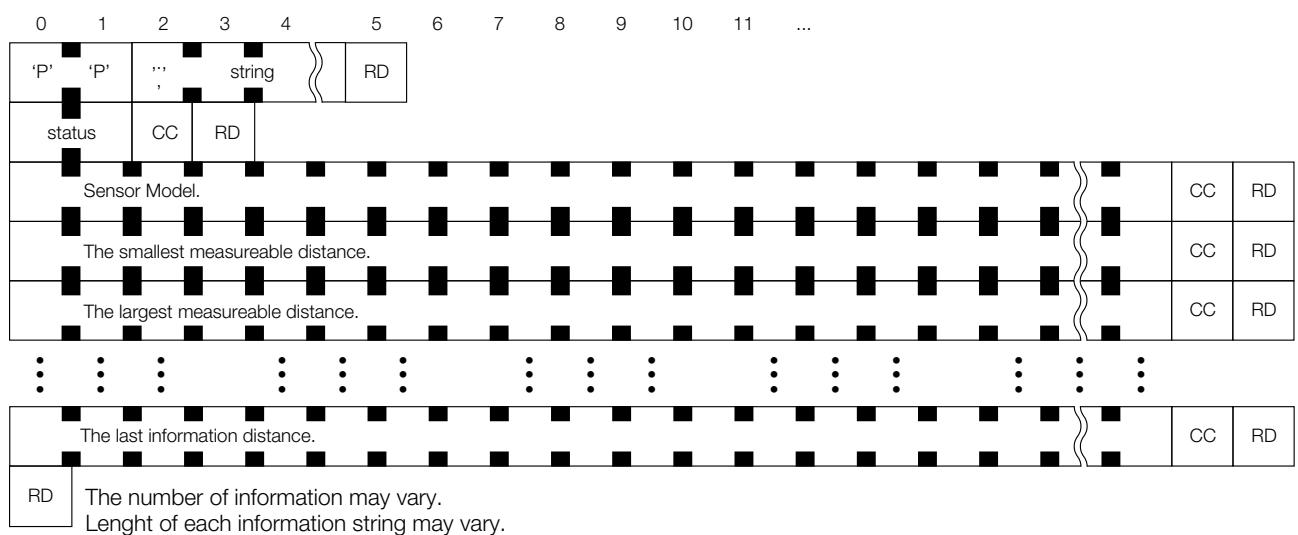
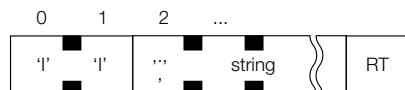
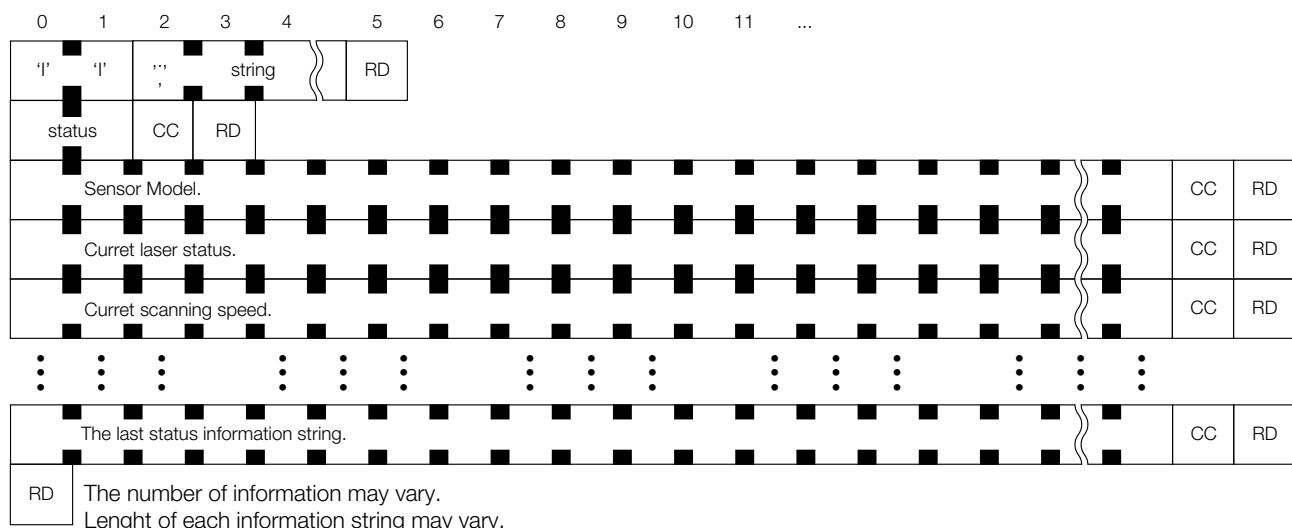


Figure 8.7.5.2 PP command Request and Response

## II request message



## II response message



Note: At the end of each information string a semicolon is added which is not a check code.  
This is an exception for VV, PP and II commands.

Figure 8.7.5.3 II command Request and Response

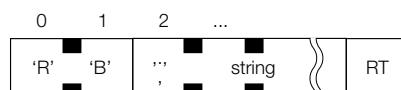
## 8.7.6 Reboot Device (RB Command)

This RB command is to reboot (restart) the sensor when it is in error state. It requires a special procedure to use it. Within 1 second, 2 request messages of the RB command must be sent and their corresponding response messages must be received (2 roundtrips of the RB command) to restart the sensor, otherwise the current sensor state is kept, and no reboot is performed. When the sensor receives the RB command, the sensor behaves as if it has just been powered up.

Table 8.7.6.1 Details of Status Code

Code	Detail
00	Normal. Received the 2nd RB command request.
01	Normal. Received the 1st RB command request.

## RB request message



## RB response message

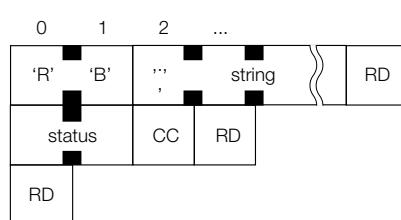


Figure 8.7.6.1 RB command Request and Response

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