RL78/I1E

Strain Gauge PC Application Software Manual

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Introduction

This application note is an instruction manual for the Strain Gauge PC Application Software, a strain gauge solution for RL78/I1E. This software operates on Excel®2013 for the Window7 PC environment.

Target Device

RL78/I1E

Contents

1. Outline

Strain Gauge PC Application Software (referred to as "PC app" herein) is designed to support the RL78/I1E strain gauge solution using a load-cell. This PC app acquires data from RL78/I1E and displays data in both numeric and graphic form. Please refer to RL78/I1E Strain Gauge Solution (R01AN2821J) for more details concerning the strain gauge solution.

This PC app provides the following functions:

- Receives data from RL78/I1E via USB communication.
- Graphs data on charts in real time
- Outputs received data to worksheets, serves as data log function.
- User can adapt MCU solution by modifying the output data format for the Excel® VBA software.
- Specific functions serving as weight scale demonstration:
  - Gram display function
    Displays measured A/D converted value in grams.
  - Zero setting function
    Calibrates current gram display to 0.0g.
  - OFFSET calibration function
    Sets the appropriate value to the D/A converter to enable the offset voltage calibration. The D/A converter is connected to the post amplifier of the RL78/I1E.
  - 3-step data calibration function
    Acquires and calibrates data in 3 steps for conversion to grams.

2. Related Documents

Documents related to this application note are shown below. Please refer to these as needed.

- RL78/I1E Strain Gauge Solution (R01AN2821J) Application Note
- RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J) Application Note

3. Operating Conditions

This section describes the operating conditions required for using the Strain Gauge PC Application Software. This PC app uses Microsoft® Excel® 2013(VBA). Make sure you have Microsoft® Excel® 2013 installed on your PC before installing this PC app.

Table 3-1 Strain Gauge PC App Operating Conditions

Item	Specification
OS	Microsoft Windows 7
Software	Microsoft® Excel® 2013

The software and examples described in this document have been confirmed under the following conditions.

Table 3-2 Operating Conditions

Item	Description
Used devices	MCU: RL78/I1E(R5F11CCC) Load cell: 1004-00.6-JW00-RS (manufactured by Tedea Huntleigh)
Evaluation board	— RL78/I1E TB board — MM-FT232 (manufactured by Sunhayato Corp.)
MCU software version	
Excel® version	RL78I1E_StrainGauge_Evaluation.xlsm・Ver.1.03

The following are usage restrictions and notes related to the use of this PC app.

— Max number of storing log value
The number of logs stored per click of the connect button is limited as follows.
- Number of measured data logs: 1,048,575 samples

— MCU serial communication settings
- Speed: 1000000bps
- Parity: none
- Stop bits: 1
- Data bits: 8

— Forced termination
Press [Ctrl] + [Break] if the Excel® app hangs up while this software is receiving data from RL78. Then, press [Stop] when the dialog box appears on the screen to terminate the communication.

— PC operation speed
Do not use auto-scale for the Y-axis setting of the Excel® graph drawing function, as it slows down the PC operation. The animation effect in Excel® causes the same problem. To avoid this problem and maintain a desirable speed, set Excel® to high priority in the task manager.

— Temporary storage of measured data
When data is received, this software creates a temporary file (log_date_time.csv) in the temporary folder (default: C:¥Users¥xxxx¥AppData¥Local¥Temp) specified by the user environment variable. This file is overwritten each time data is received. Therefore, data is always stored in the temporary file, even if an error occurs during communication and Excel® is stopped. Note that files cannot be opened during communications.

4. Quick Start Guide

4.1 Preparation

Before using this PC app, please set up the hardware environment as follows:

(1) Program the respective application firmware to the RL78/I1E MCU.
(2) Install the USB driver.
(3) Connect RL78/I1E TB and MM-FT232.
(4) Connect RL78/I1E TB and the load cell.

Steps (1) to (3) above are described in section 3.1 Preparation, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J)**.

The connection between RL78/I1E and the load cell in Step (4) is described in Table 4-1.

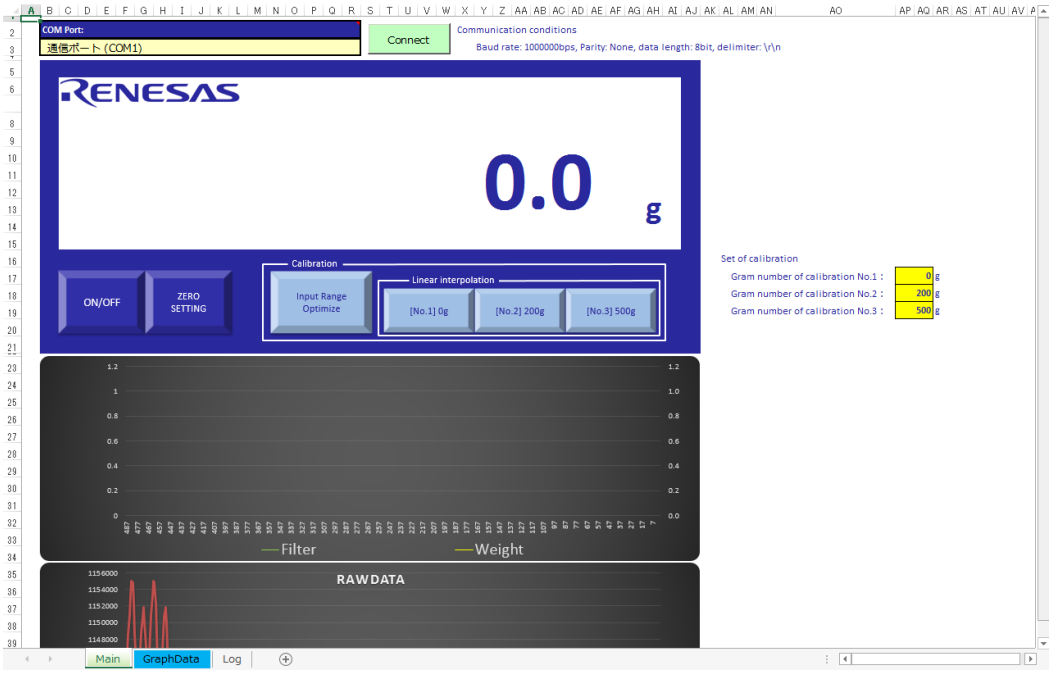
Table 4-1 Connection Between RL78/I1E TB and Load Cell 1004-00.6-JW00-RS

RL78/I1E TB	Load Cell
SBIAS	+Input
VSS	-Input
PGA0P	+Output
PGA0N	-Output

4.2 Data Acquisition from COM Port

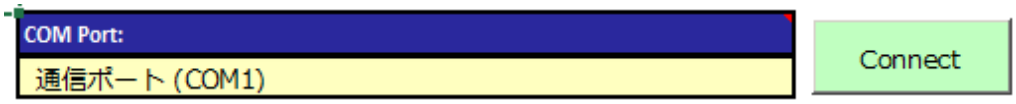
(1) Start up Strain Gauge PC Application Software.

(2) Open Main sheet in Excel®.



(3) Set serial communication

Although the example below shows COM1, the COM port used by your PC will appear automatically in the pull down menu. Select the correct one and click [Connect].

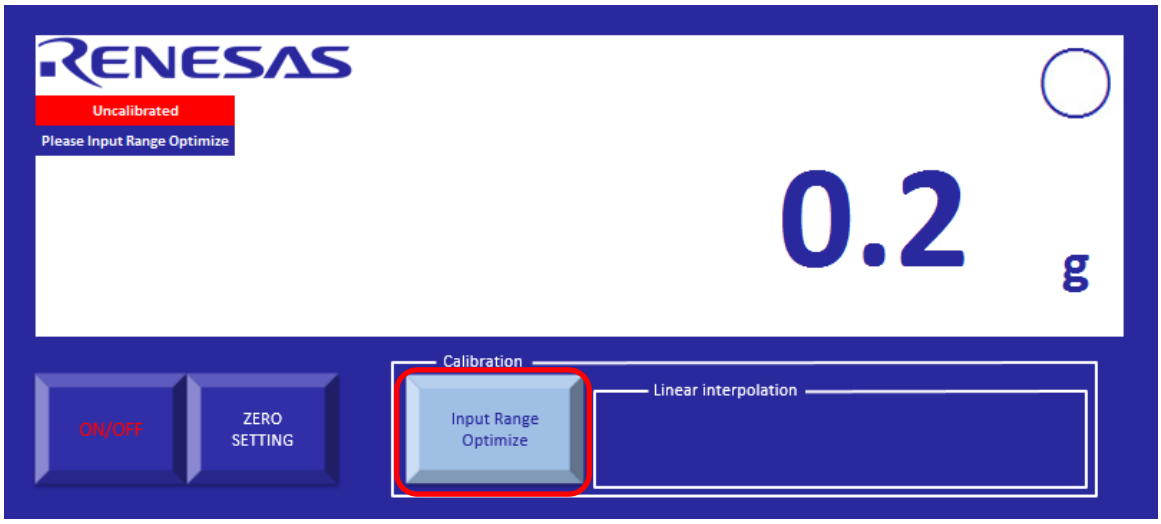


(4) After clicking [Connect], click the [ON/OFF] button to start communication.

Icon before clicking [Connect] Icon after clicking [Connect]

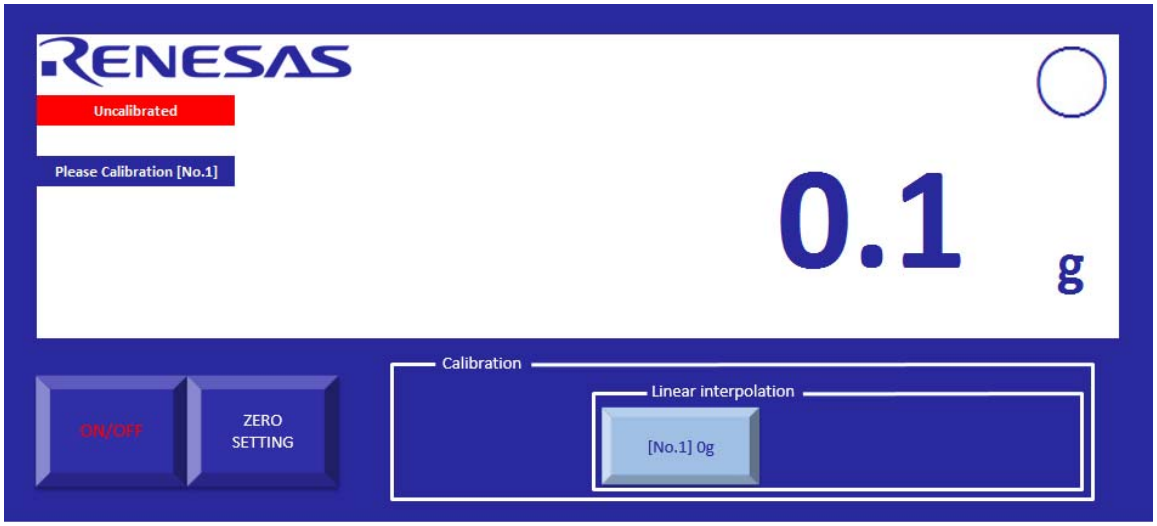
(5) Click [Input Range Optimize] button

This function sets the appropriate value to the D/A converter to enable the offset voltage calibration. The D/A converter is connected to the post amplifier of the RL78/1IE. Do not place anything other than the weighing tray on the load cell as it must be calibrated to 0g.

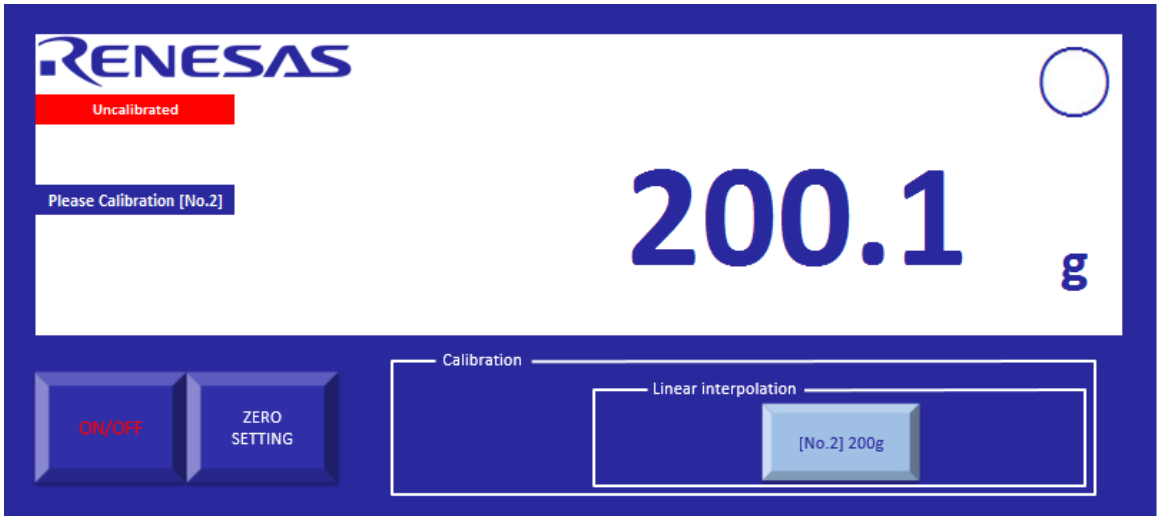


(6) Carry out 3-step calibration: first perform Calibration No. 1

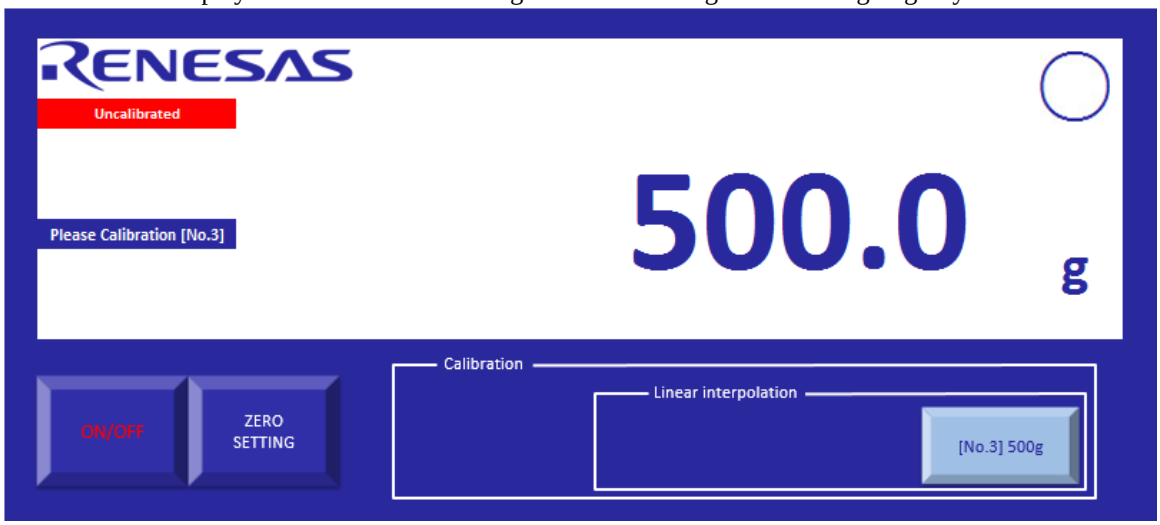
Calibration No. 1 sets the system to 0g. To ensure an accurate calibration, do not place anything other than the weighing tray on the load cell.



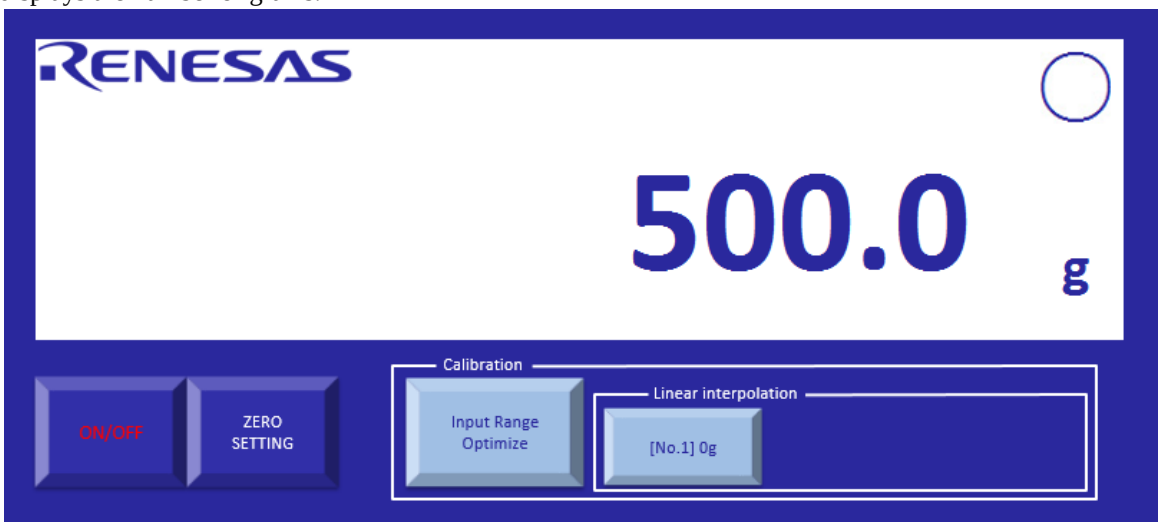
(7) When the displayed value in step (6) has stabilized, click the “[No. 1] 0g” button. The circle at the upper right of the window indicates that the value has stabilized. The weight is considered stable when the same value is displayed for 1.5 seconds. The second calibration starts when the display switches windows as shown below. At this time, place a 200g weight on the weighing tray.



(8) When the displayed value in step (7) has stabilized, click the " [No. 2] 200g" button. The third calibration starts when the display switches to the following. Place a 500 weight on the weighing tray.



(9) When the displayed value in step (8) has stabilized, click the "[No. 3] 500g" button. This completes the 3-step calibration process. When "[No. 3] 500g" is clicked, the program switches to normal measurement mode and displays the number of grams.



(10) After completing the evaluation, click [ON/OFF] to end communication. Each time communication is ended the program automatically generates a new measured data log sheet.

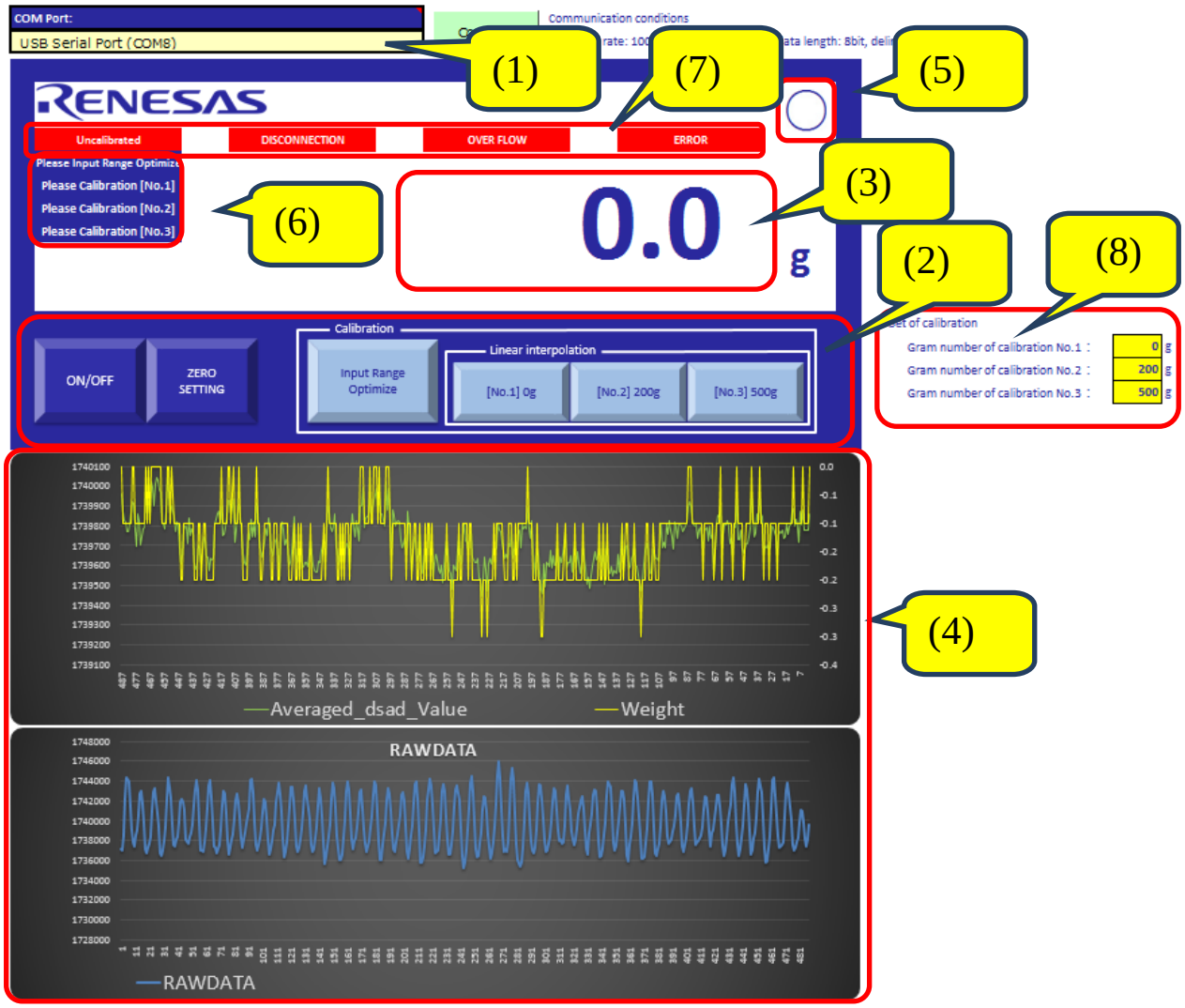
5. Function Descriptions

The R78/I1E Strain Gauge PC Application Software uses the following worksheets: Main, GraphData, Log, and Measured Data Log. This section describes each sheet in detail.

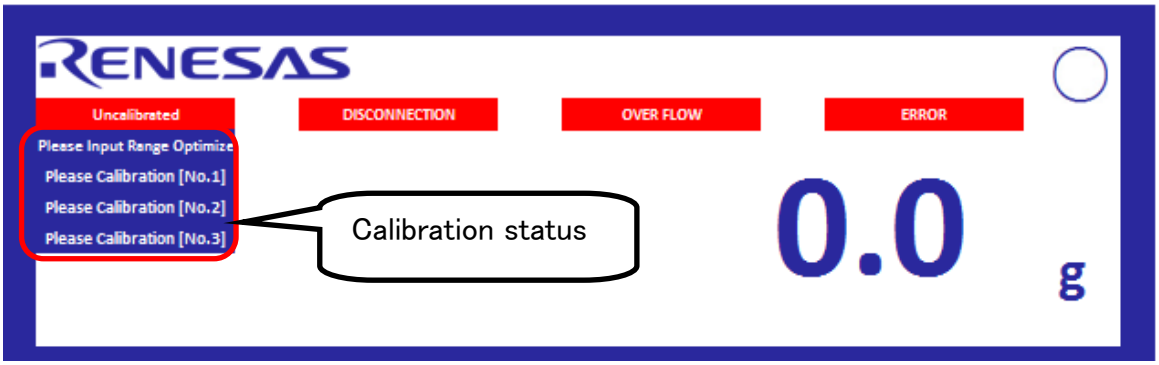
5.1 Main Sheet

In the Main sheet, you will be able to adjust the following: (1) COM port setting, (2) operation buttons, (3) gram display, (4) graph display, (5) stabilization symbol display, (6) calibration status display, (7) error display, and (8) calibration weight change.

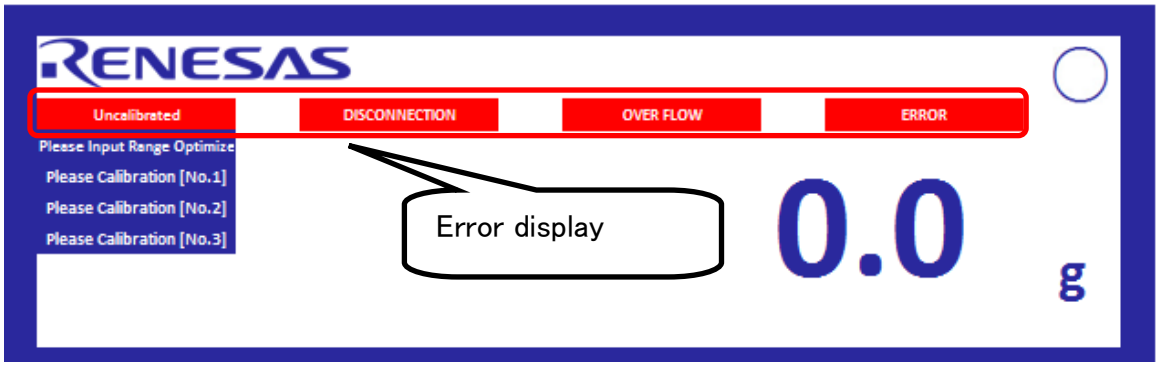
Communication conditions:
Baud rate: 1000000bps; parity: none; data length: 8 bits; delimiter: ¥r¥n



1. COM port setting
   This allows the user to select the appropriate COM port for connecting the PC to the evaluation board. The COM port can be selected after the PC and board are connected via USB and the driver has been installed.
2. Operation buttons
   The operation buttons enable the following functions. Some buttons require a specific order of operations to execute the function. Only the buttons that operable in each function or state are displayed on the screen.
   - ON/OFF
     Switches the COM port between OPEN and CLOSED, and is always operable.
   - Zero setting
     Calibrates the displayed state to 0g. The button is not operable during calibration operations (when calibration status is displayed).
   - Input Range Optimize
     This function sets the appropriate value to the D/A converter to enable the offset voltage calibration. This D/A converter is connected to the post amplifier of the RL78/I1E. Always carry out a 3-step calibration after using this button. This button is disabled once the calibration operation starts (when “Uncalibrated” is displayed).
   - Calibration [No. 1] 0g
     Stores the A/D converted value. Always carry out Calibration No. 2 after this step is completed. This button is disabled when calibration No. 2 or 3 is being carried out.
   - Calibration [No. 2] 200g
     Stores the A/D converted value. Always carry out Calibration No. 3 after this step is completed. This button is disabled when Calibration No. 1 or 3 is being carried out.
   - Calibration [No. 3] 500g
     Stores the A/D converted value. This button is disabled when Calibration No. 1 or 2 is being carried out. Note that the calibrated data is written to the RL78/I1E flash memory after this button is clicked.
3. Gram display
   Displays the value of the most recently received measured data in grams.
4. Graph display
   Displays the received data in graph form. The graph displays 488 data samples. Excel® functions are used to draw the graph, enabling the user to copy and paste additional data in the sheet as required. The user can also modify the data if necessary to display in the graph. In the previous example, the upper section shows A/D converted values and gram equivalent values after the filtering calculation. The lower section displays the A/D converted values as raw data.
5. Stabilization display
   When the gram display has stabilized, a circle will appear in the upper right corner. The value is considered stable when the number of grams remains the same for over 1.5 seconds. The circle is not displayed when the value is unstable.
6. Calibration status display
   This screen displays the status of the calibration: Input Range Optimize, Calibration No. 1, Calibration No. 2, and Calibration No. 3.



7. Error display



The following describes the types of errors that may appear in the error display.

— Uncalibrated

Displayed when calibration has not been performed or is in progress. Calibrated data is automatically written to the flash memory after calibration has been performed. Therefore, the next time the program is booted up, data is read from the flash memory, signaling a calibration has been performed, and this error will no longer be displayed.

— Overflow

Indicates an overflow of the measured A/D-converted value. When this error occurs, click the [Input Range Optimize] button and carry out the calibration process.

— Disconnection

Indicates the sensor and programmable gain instrumentation amp have been disconnected. When this error occurs, make sure the wire connection between the sensor and the amp is secure.

— Error

Indicates the measured load exceeds the maximum weight the load cell can measure.

8. Calibration weight setting

This table enables the user to change the calibration loads. When changing these values, note that calibration values differ according to the MCU firmware; make sure the set values are in sync with your MCU software. Although calibration will be carried out even if the set value does not comply with the target MCU, the output result will not be valid.

5.2 GraphData Sheet

This GraphData sheet holds the data used for graphs in the Main sheet. Data is received from the evaluation board and displayed successively by the strain gauge PC app. For details, refer to section 4.2 GraphData Sheet, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J).**

5.3 Log Sheet

The log sheet stores the log history of operations and communications. Each log records the date and time, status, and a description of the operation carried out. For details, refer to section 4.3 Log Sheet, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J).**

5.4 Measured Data Log Sheet

Each time a measurement is completed, a measured data log sheet is automatically generated and the measured data is output to the sheet. For details, refer to section 4.3 Measured Data Log Sheet, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J).**

6. Communication with the Target MCU

6.1 Outline

The strain gauge PC app communicates with the MCU in a dedicated text-based format. The communication specifications are basically the same as those of the Analog Characteristics Evaluation PC Application Software. This section describes the specifications unique to the Strain Gauge PC Application Software.

For more details, please refer to section 5. Communication with the Target MCU, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J).**

6.2 Communication Commands from MCU to Strain Gauge PC App

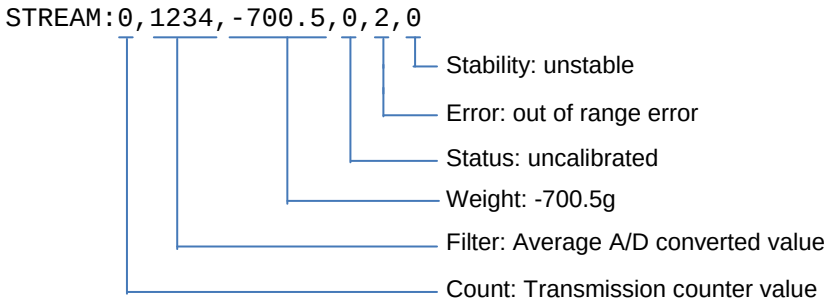
6.2.1 Stream Transfer

Although there are no restrictions for stream transfers when using the Analog Characteristics Evaluation PC Application Software, this strain gauge app was developed based on the following data format for data received in a stream transfer.

When starting communication with ON/OFF button:

STREAMHEADER:Count,Filter,Weight,Status,Error,Stability

Per 500msec period *Numbers are only an example.



Each type of data is transmitted within the following ranges.

Table 6-1 STREAM Transfer: Data Range

Data	Range	Comment
Count	0 to 4294967296	Increments from 0 (default).
Filter	-8388608 to 8388607	
Weight	No specified range	
Status	0 Uncalibrated 1 OFFSET calibration executed 2 Calibration No. 1 executed 3 Calibration No. 2 executed 4 Calibration No. 3 executed, normal measurement	“Uncalibrated” is displayed for all statuses, excluding status 4.
Error	0x00 No disconnection detected, no overflow, and no out of range error 0x01 Overflow state 0x02 Out of range error state 0x80 Disconnection detected state	
Stability	0 Unstable 1 Stable	

6.2.2 Bulk transfer

Although there are no restrictions for bulk transfers when using the Analog Characteristics Evaluation PC Application Software, the strain gauge PC app was developed based on the following data format for data received in a bulk transfer.

When starting communication every 500 data sample period:

```
BULKSTART:500 Count RAWDATA
```

Every time 25 data samples accumulate: *Numbers are only an example.

```
BULK:0
00000000,00000000,00000000,00000000,00000000,
00000000,00000000,00000000,00000000,00000000,
00000000,00000000,00000000,00000000,00000000,
00000000,00000000,00000000,00000000,00000000,
00000000,00000000,00000000,00000000,00000000
```

After 500 data samples are sent:

```
BULKEND:0
```

Each type of data is transmitted in the following data ranges.

Table 6-2 Bulk Transfer Data Range

Data	Range	Comment
Count	0 to 65536	Increments from 0 (default).
RAWDATA	-8388608 to 8388607	

6.3 Commands from Strain Gauge PC App to MCU

Table 6-3 lists the communication commands used between the strain gauge PC app and the target MCU. Clicking each button in this PC app sends the corresponding command to the MCU for execution. Note that, although commands are common with the Analog Characteristics Evaluation PC Application Software, commands @1 to @5 are unique to the strain gauge PC app. Refer to section 5. Communication with the Target MCU, **RL78/I1E Analog Characteristics Evaluation PC Application Software Manual (R01AN2820J).**

Table 6-3 Communication Commands

Command	Button
@0	ON/OFF
@1	Zero setting
@2	Calibration 0g
@3	Calibration 200g
@4	Calibration 500g
@5	Input Range Optimize

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Nov. 09, 2015	---	First edition issued

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   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
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3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

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