RL78/I1E

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Analog Characteristics Evaluation PC Application Software Manual

Introduction

This application note is an instruction manual for RL78/I1E Analog Characteristics Evaluation PC Application Software. This software runs with Excel® 2013 in the Window7 environment.

Target Device

RL78/I1E

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1. Outline

RL78/I1E Analog Characteristics Evaluation PC Application Software (referred to as "PC app" herein) must be executed with Excel®in the Window7 environment. This PC app acquires and stores data from RL78/I1E to analyze data for evaluating the analog functions of the MCU, in particular the characteristics of the 24-bit ΔΣA/D converter with programmable gain instrumentation amplifier. The PC app provides the following functions.

- USB interface allows data to be received from RL78/I1E.
- Draws data in a line graph in real time.
  Option to receive binary data without drawing a graph, depending on the A/D operation mode, data transfer speed, and/or quantity of data handled.
- Log function can also output received data to worksheets.
- Allows user to edit received data without modifying Excel® VBA program.

This document describes how to use the PC app.

2. Operating Conditions

This section describes the operating conditions required by the PC app. Microsoft® Excel® 2013 (VBA) is used in combination with the PC app and must be installed on your PC before installing this software.

Table 2-1 PC App Operation Environment

Software Type	Product
OS	Microsoft Windows 7
Application	Microsoft® Excel® 2013

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

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

— MCU serial communication settings
- Speed: 2000000bps
- Parity: none
- Stop bits: 1
- Data bits: 8

— Forced termination
Press [Ctrl] + [Break] if Excel® hangs up while this software is receiving data from RL78. Then, click [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 in the Excel® graph drawing function, as it slows down the PC operation. The animation effect in Excel® causes the same problem. To avoid this, 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 communication.

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

Table 2-2 Operating Conditions

Item	Description
Used devices	RL78/I1E(R5F11CCC)
Evaluation board	RL78/I1E TB board MM-FT232 (manufactured by Sunhayato Corp.)
MCU software version	
Excel® version	RL78I1E_Analog_Characteristics_Evaluation.xlsm・ver.1.01

3. Quick Start Guide

3.1 Preparation

3.1.1 Program firmware to RL78/I1E MCU

To run the PC app, first program the Analog Characteristics Evaluation sample code to RL78/I1E using the Renesas Flash Programmer, CS+ or a programming tool provided by a third party. Refer to the target MCU's user's manual for more details.

3.1.2 Install driver

Sunhayato's USB serial conversion module MM-FT232 is equipped with interface controller FT232RQ, manufactured by FTDI. Install the FT232RQ driver by downloading it from the FTDI website (http://www.ftdichip.com/).

3.1.3 Connect PC and RL78/I1E

This PC app uses a COM port to communicate with the target MCU. If the MCU evaluation board or your PC is not equipped with RS-232C, connect the PC and RL78/I1E using the USB interface with a virtual COM port (VCP).

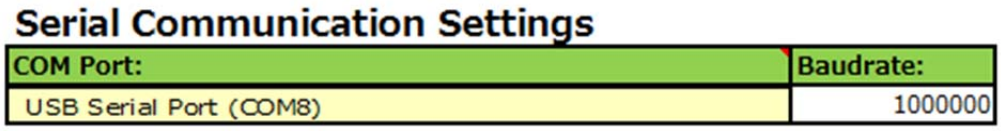
For example, when connecting RL78/I1E TB (Naito Densei Machida MFG) and MM-FT232 (Sunhayato), power is supplied from the USB bus of MM-FT232.

Table 3-1 RL78/I1E TB and MM-FT232 Pin Setting

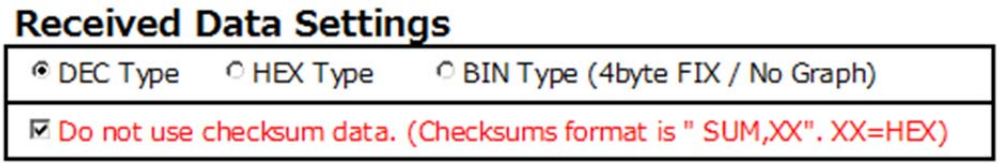
RL78/I1E TB	MM-FT232
P11/SI01/RXD1/SDA01/TI03/TO03/INTP2/TRGCLKA/TRJIO0	TXD
P10/SO01/TXD1/TI01/TO01/INTP1/TRGIOA	RXD
VSS	GND
VDD	5V/3V3

3.2 Data Acquisition from COM Port

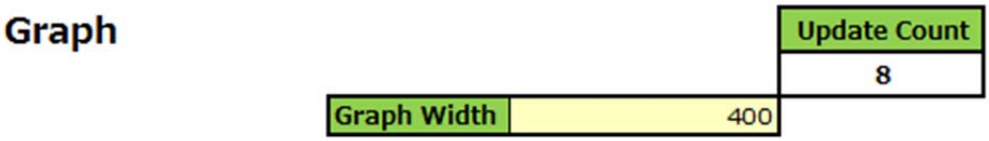
(1) Start Analog Characteristics Evaluation PC Application Software.
(2) Open Main sheet in Excel®.
(3) Set serial communications
Although the example below shows COM8, the COM port used by your PC will appear automatically in the pull down menu. Select the valid one and confirm that the bit rate is set to 1000000.



(4) Select receive data setting.
Check the receive data format from the MCU. Make sure the data format is decimal, as shown below.



(5) Check graph display quantity (# of plots) and frequency of updates.
Check that the graph parameters are set as shown below.



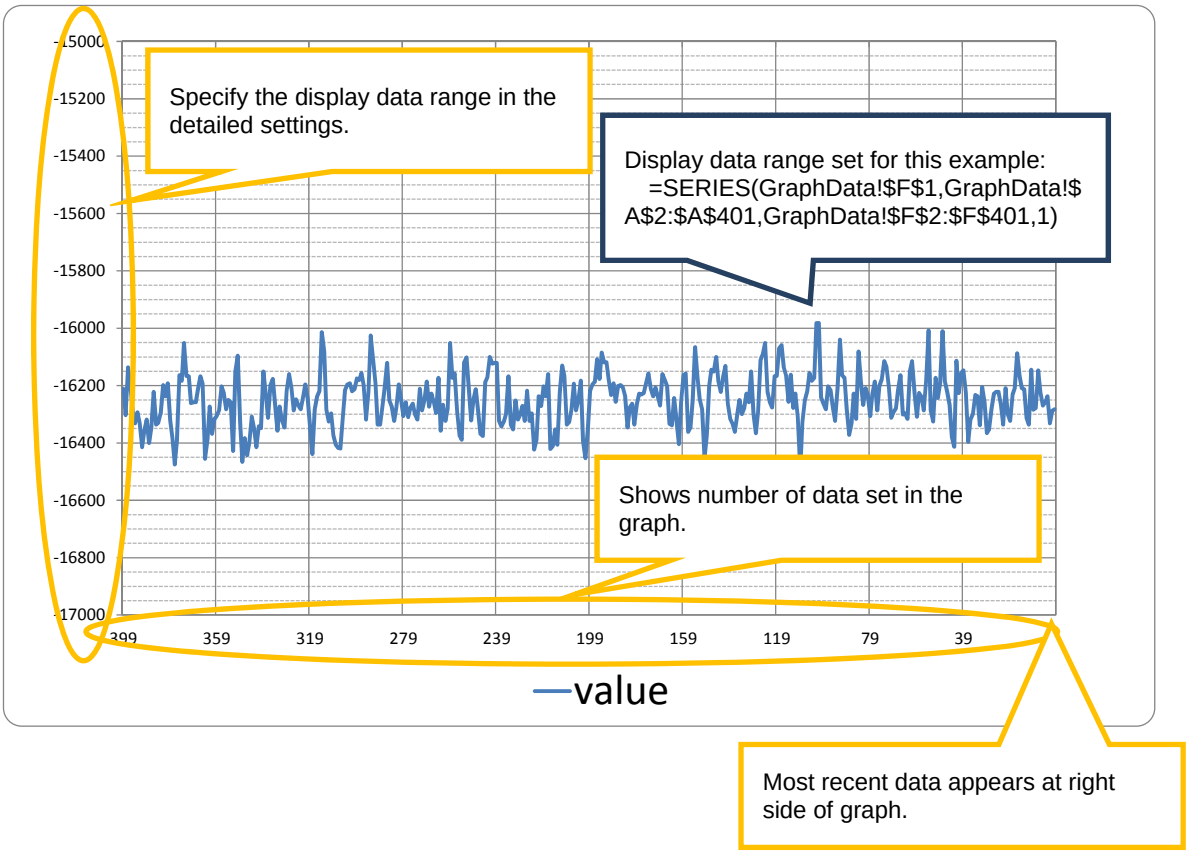
(6) Connect the MCU.
Click the [Connect] button and confirm that the status has been updated as shown below. If [Invalid Connect!] appears after clicking [Connect], check the cable connection between the evaluation board and the PC, and make sure the valid COM port is selected.

Before clicking [Connect]

After clicking [Connect]

(7) Click [ON/OFF] to start data acquisition.
(8) Received data appears in graph area.

The data in the GraphData sheet will be plotted on the graph automatically. Change the scale of the vertical axis to match the data range, as shown in the example below.



Although the above example shows only one series of data, multiple data series can be added.

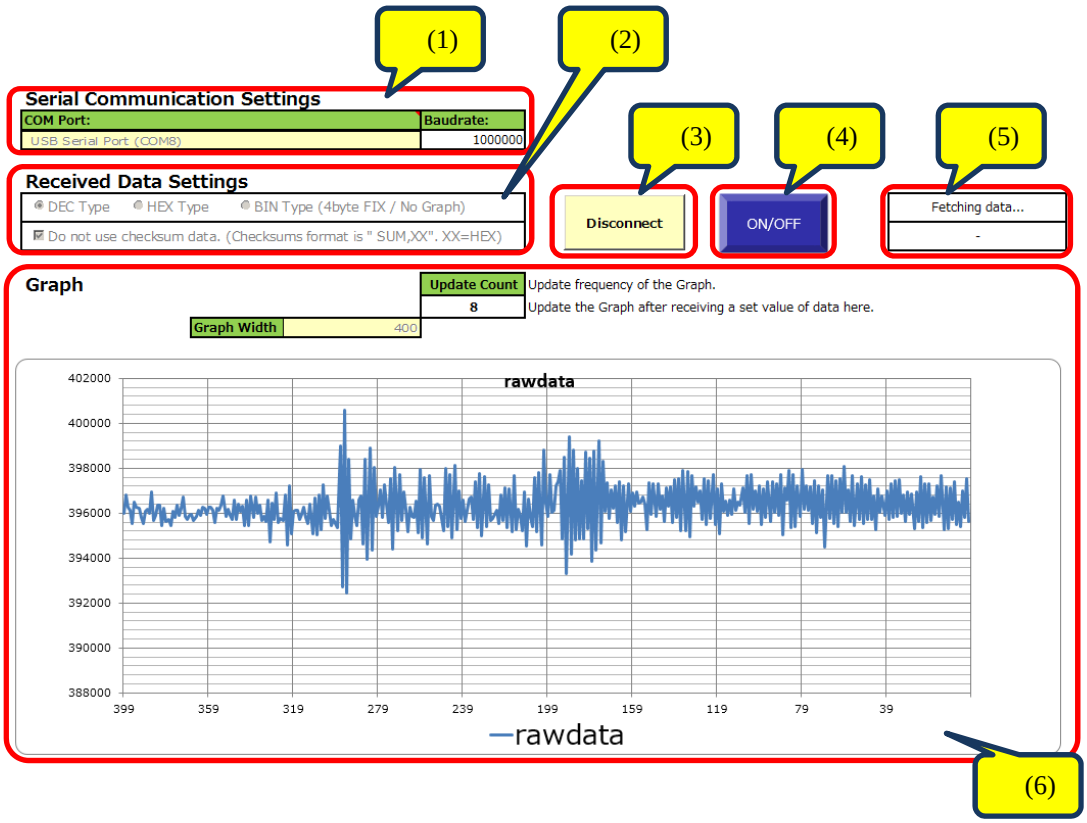
(9) When the evaluation is completed, click [ON/OFF], then [Disconnect], in this order, to terminate the communication.
(10) A new measured data log sheet will be automatically added as a new sheet in the same file.

4. Function Explanations

RL78/I1E Analog Characteristics Evaluation PC Application oftware uses the following worksheets: Main, GraphData, Log, and Measured Data Log. This section describes each sheet in detail.

4.1 Main Sheet

In the Main sheet, you will be able to: (1) set serial port setting, (2) select receive data format, (3) connect/disconnect communication, (4) turn on/off data acquisition, (5) display the communication status, and (6) draw the measured data graph.



(1) Serial Port Setting

COM port selection

Selects the COM port for connection to the evaluation board. This selection is only valid after connecting the evaluation board to the PC with a USB cable and installing the driver.

Bit rate

Sets the bit rate. Specify the value in accordance with the bit rate specified in the target MCU software. This sample is set to 1000000bps.

(2) Receive Data Format Setting

Allows the user to select the receive data format from the following: decimal, hexadecimal, and binary (4-byte fixed/no graph). The user can also select whether to add the checksum at the end of data (exclusive OR of the set of data: 1 byte). This setting should also be made in accordance with the target MCU software.

(3) Connect/Disconnect

When the [Connect] button is clicked, the icon switches to [Disconnect], communication with the MCU is started, and the color of the characters on the [ON/OFF] button changes to red. Similarly, when the [Disconnect] button is clicked, communication with the MCU is terminated and the color of the characters on the [ON/OFF] button goes to white. When [Disconnect] is clicked, a new sheet of data is created.

(4) ON/OFF

Clicking the ON/OFF button starts/stops data acquisition.

(5) Communication Status Confirmation

Displays the status of communication with the PC. Displays various communication statuses, such as: Complete: communication completed; Fetching data...: acquiring data now.

(6) Graph of Measured Data

Graph display quantity (# of plots)

Specifies how many data entries are displayed per graph.

Graph Update Frequency/Quantity

Sets the frequency for updating the graph. The graph is updated each time the specified number of data entries is received. Note, the lower the value, the more frequent the graph is updated, which slows down the CPU.

Graph Area

Sets the number of display data for the X-axis. 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 data as necessary for display in the graph

4.2 GraphData Sheet

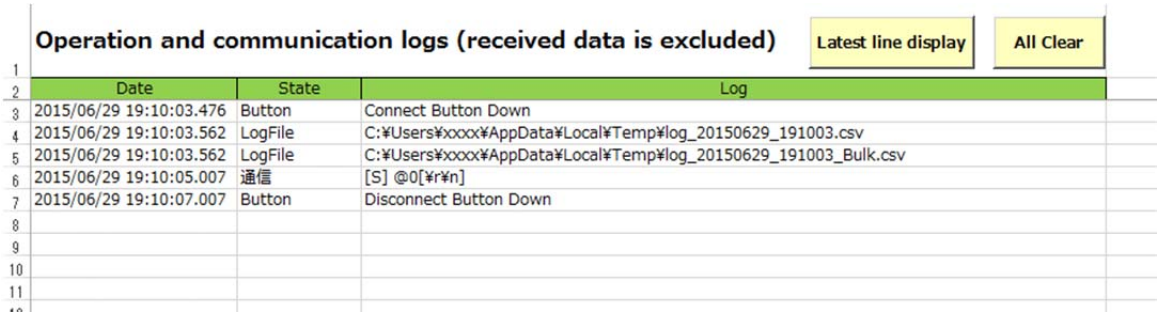
This GraphData sheet holds the data which is used for the graph in the Main sheet. Data is received from the evaluation board and displayed successively by the PC app. When the received data exceeds the specified maximum number of data for the Main sheet graph, the older data is automatically deleted. The data is plotted from left to right on the graph. Therefore the most recent data always appears on the right side. To offer this feature, the GraphData sheet has a ring buffer function. For example, when the graph display quantity in the Main sheet is set to 400, the value in the 401st row on the GraphData sheet is updated to the latest value, and the value in the 2nd row becomes the oldest value.

	A	B	C	D	E	F	G	H	I
1	count	Time	count	gain_set1	gain_set2	offset	rawdata	correct	error
2	399	2015/06/29 18:34:38[054]	3696	8	2	16	395374	24710	0
3	398	2015/06/29 18:34:38[054]	3697	8	2	16	397859	24866	0
4	397	2015/06/29 18:34:38[054]	3698						0
5	396	2015/06/29 18:34:38[140]	3699						0
6	395	2015/06/29 18:34:38[140]	3700						0
7	394	2015/06/29 18:34:38[140]	3701						0
8	393	2015/06/29 18:34:38[140]	3702						0
9	392	2015/06/29 18:34:38[140]	3703						0
10	391	2015/06/29 18:34:38[140]	3704						0
11	390	2015/06/29 18:34:38[203]	3705						0
12	389	2015/06/29 18:34:38[203]	3706						0
13	388	2015/06/29 18:34:38[203]	3707						0
14	387	2015/06/29 18:34:38[203]	3708						0
15	386	2015/06/29 18:34:38[203]	3709	8	2	16	397568	24848	0
16	385	2015/06/29 18:34:38[203]	3710	8	2	16	395084	24692	0
17	384	2015/06/29 18:34:38[257]	3711	8	2	16	397544	24846	0
18	383	2015/06/29 18:34:38[257]	3712	8	2	16	394943	24683	0
19	382	2015/06/29 18:34:38[257]	3713	8	2	16	397465	24841	0
20	381	2015/06/29 18:34:38[257]	3714	8	2	16	395672	24729	0
21	380	2015/06/29 18:34:38[257]	3715	8	2	16	396754	24797	0
22	379	2015/06/29 18:34:38[257]	3716	8	2	16	395442	24715	0
23	378	2015/06/29 18:34:38[320]	3717	8	2	16	396882	24805	0
24	377	2015/06/29 18:34:38[320]	3718	8	2	16	395132	24695	0
25	376	2015/06/29 18:34:38[320]	3719	8	2	16	396531	24783	0
26	375	2015/06/29 18:34:38[320]	3720	8	2	16	395573	24723	0
27	374	2015/06/29 18:34:38[320]	3721	8	2	16	397362	24835	0
28	373	2015/06/29 18:34:38[320]	3722	8	2	16	395815	24738	0
29	372	2015/06/29 18:34:38[382]	3723	8	2	16	397180	24823	0
30	371	2015/06/29 18:34:38[382]	3724	8	2	16	395942	24746	0

When the Streamheader data is received from the MCU, the strings in the data are displayed here in order. For more details, refer to section 5. Communication with the MCU.

4.3 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.



Operation and communication logs (received data is excluded) [Latest line display] [All Clear]

Date	State	Log
2015/06/29 19:10:03.476	Button	Connect Button Down
2015/06/29 19:10:03.562	LogFile	C:¥Users¥xxxx¥AppData¥Local¥Temp¥log_20150629_191003.csv
2015/06/29 19:10:03.562	LogFile	C:¥Users¥xxxx¥AppData¥Local¥Temp¥log_20150629_191003_Bulk.csv
2015/06/29 19:10:05.007	通信	[S] @0[¥r¥n]
2015/06/29 19:10:07.007	Button	Disconnect Button Down

- Latest Row Display
  Clicking this button takes the cursor to the latest row of data in the log.
- Clear All
  Clicking this button displays the confirmation window. Select [Agree] to clear all logs.

4.4 Measured Data Log Sheet

A new measured data log sheet is automatically generated each time a measurement is completed, and the measured data is output to the sheet. A new sheet is added each time [Disconnect] is clicked after communication is started. The name of each sheet consists of the date and time (yyyymmdd_hhmmss) the measurement was initiated (example: “20150521_164548.”)

5. Communication with the Target MCU

5.1 Outline

This PC app has four types of protocols to communicate with the MCU.

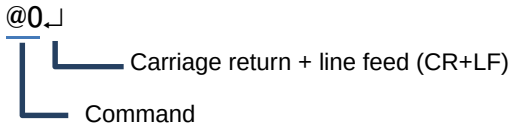
- Commands from this PC app to the MCU
- Stream transfer: sends data from the MCU at regular intervals
- Bulk transfer: sends a large number of data on request
- Binary transfer: sends a large number of data at high speed

The stream transfer is considered useful for sending A/D converted results to the PC at regular intervals, as the data can be displayed the moment it is received. On the other hand, the bulk transfer is handy when sending a large number of data, such as for Fourier-transformed results, at one time. The data is displayed after the data send operation is complete.

* These are only general descriptions, not restrictions; A/D converted values can also be sent bulk transfers.

5.2 Communication Commands from PC app to MCU

The PC app sends a command to the MCU to start/terminate a measurement operation. As the MCU is limited in resources, its command format is extremely simple (4-byte fixed).



5.3 STREAM Transfer

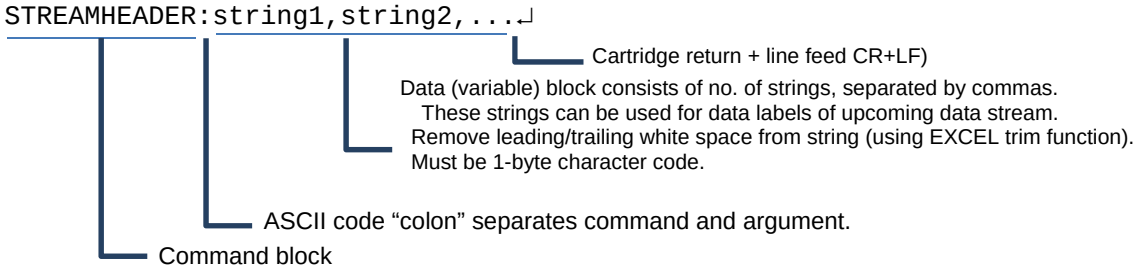
Stream transfer is used to send each measurement result from the MCU on a regular basis, allowing the data to be reflected in the graph as soon as it is received.

Stream transfer employs ASCII code to send numeric data, such as A/D converted results, by converting that data into a character string with sprint or similar format. Stream transfers have two commands, STREAMHEADER and STREAM.

5.3.1 Command Descriptions

(1) STREAMHEADER command format

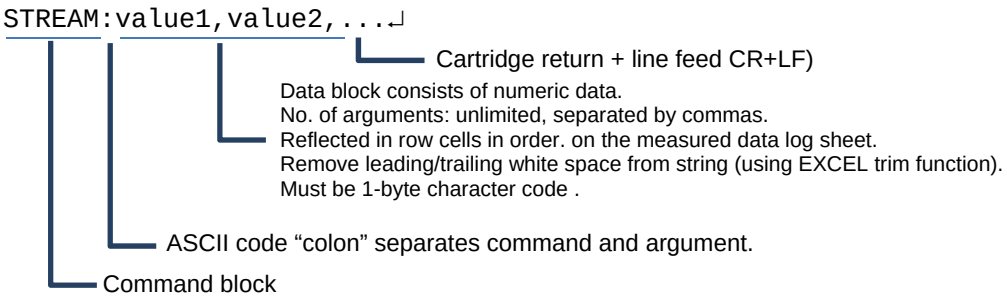
When the PC app receives the STREAMHEADER command, it includes the number of data to be received.



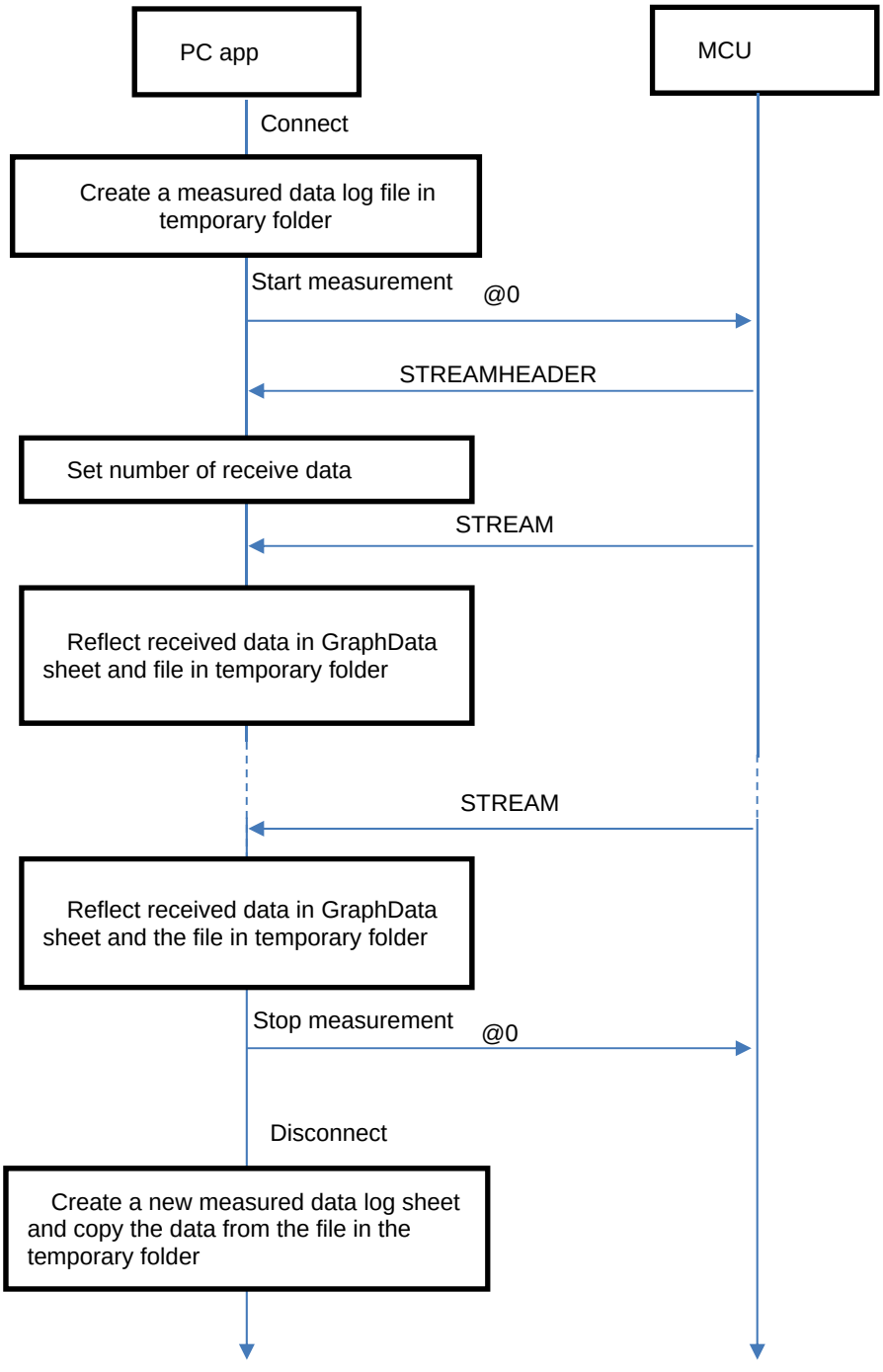
(2) STREAM command format

When the PC app receives the STREAM command, it places the received data in the GraphData sheet.

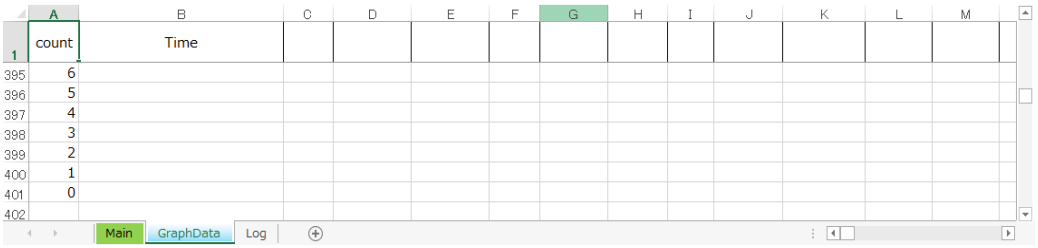
The data can be plotted in the graph in real time by setting the Main sheet graph reference range to correspond with the GraphData range.



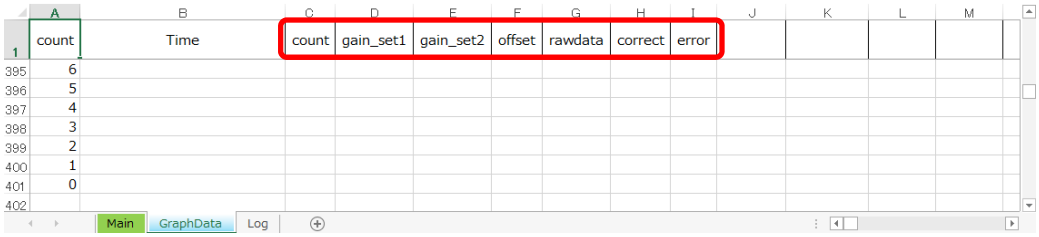
5.3.2 Sequence



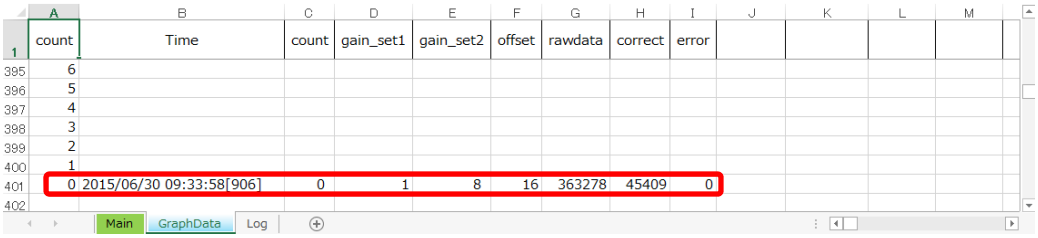
5.3.3 Operation Example



Received data STREAMHEADER:count,gain_set1,gain_set2,offset,rawdata,correct,erro



Received data STREAM:0,1,8,16,363278,45409,0



5.4 BULK Transfer

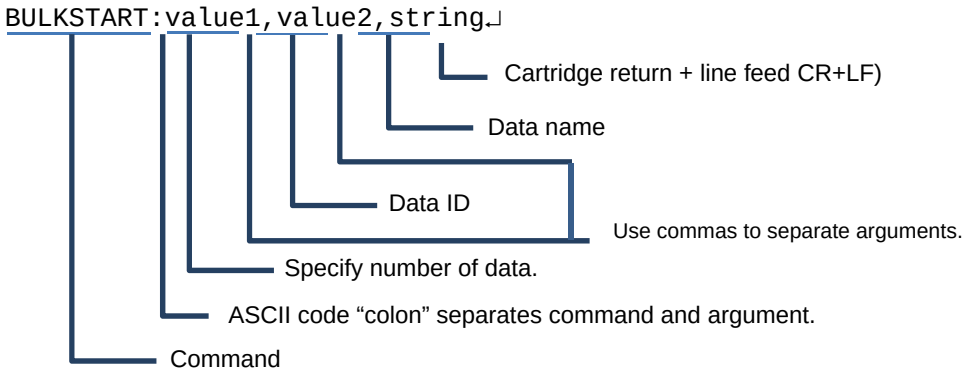
The bulk transfer is used to send a large set of accumulated data from the MCU as requested, rather than sending one data at a time on a regular basis.

Bulk transfers have three commands, BULKSTART, BULK, and BULKEND commands.

5.4.1 Command Descriptions

(1) BULKSTART command format

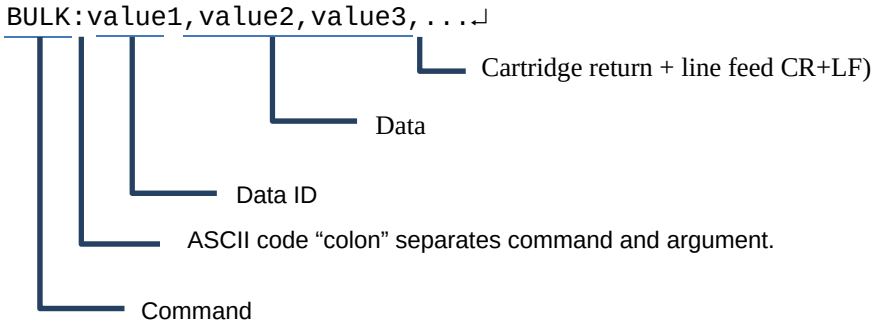
When the PC app receives the BULKSTART command, it prepares a buffer for the number of receive data specified in the argument.



(2) BULK command format

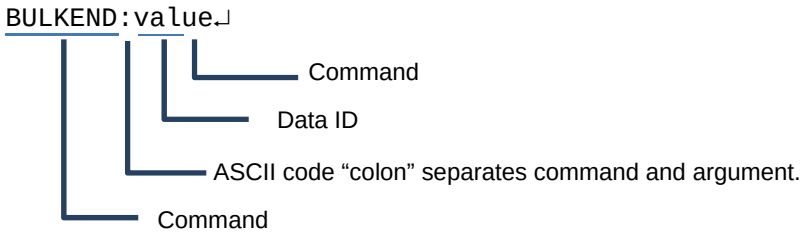
When the PC app receives the BULK command, it stores the data in the buffer prepared in response to the BULKSTART command. Depending on the quantity of data received, the PC app will either receive the BULKEND command or continue to store data until it receives the specified number of data.

When “value1” is received and it does not match with the data ID specified in the BULKSTART command, the PC app discards the following data.

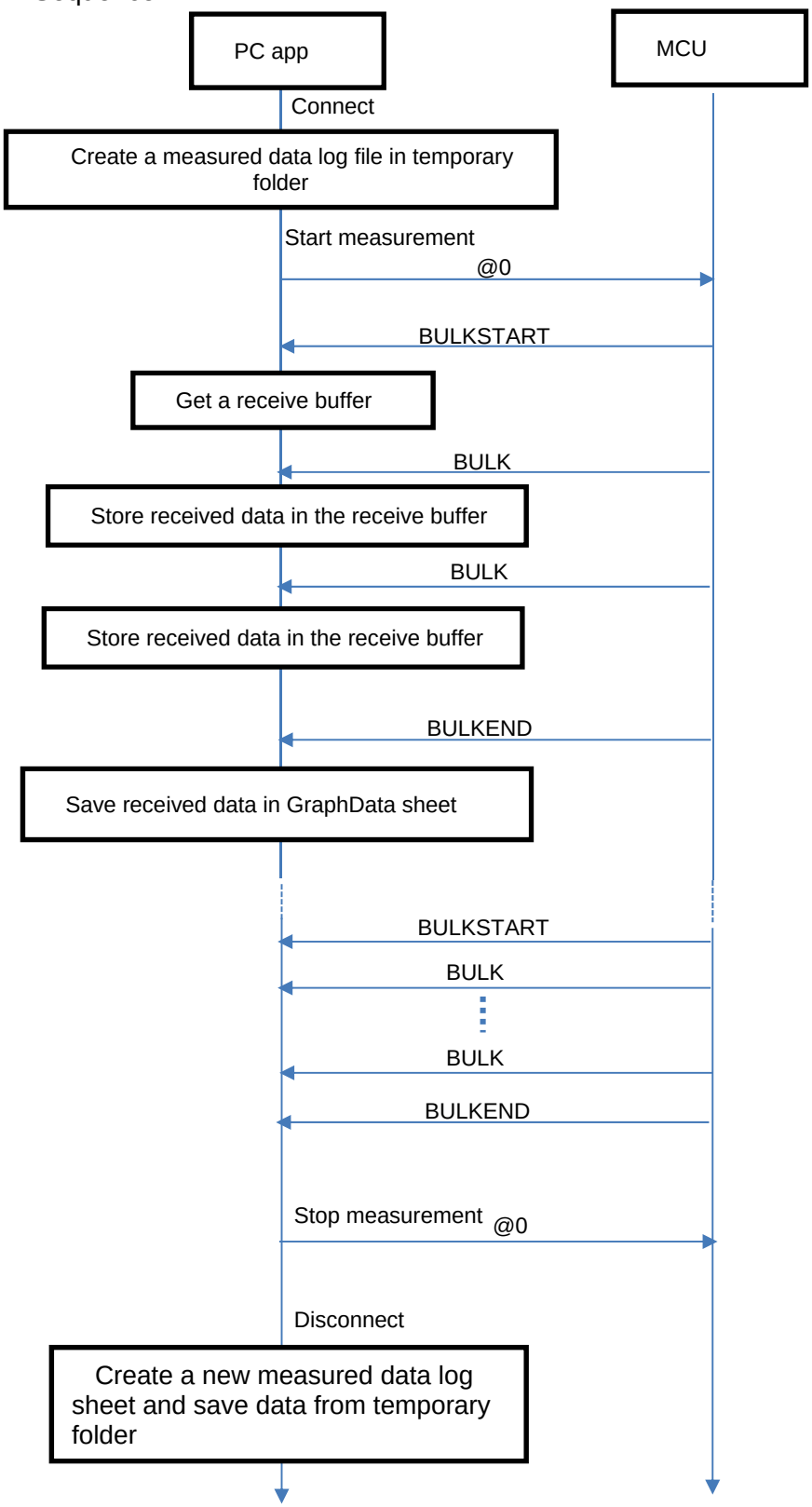


(3) BULKEND command format

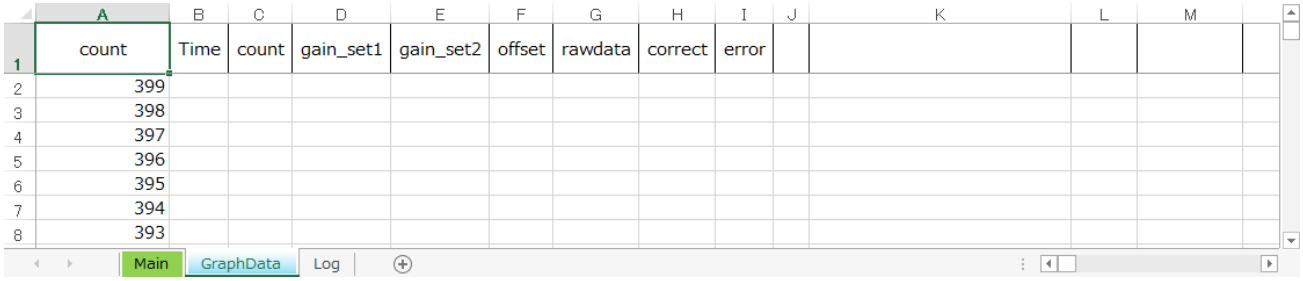
When the PC app receives the BULKEND command, it stores the data received in the BULK command in the GraphData sheet.



5.4.2 Sequence



5.4.3 Operation Example

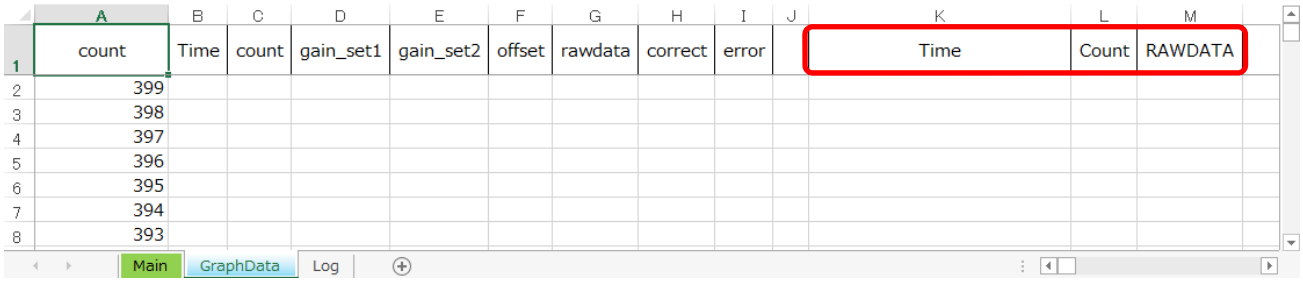


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	count	Time	count	gain_set1	gain_set2	offset	rawdata	correct	error				
2	399												
3	398												
4	397												
5	396												
6	395												
7	394												
8	393												

Main GraphData Log

Received data

BULKSTART:100,0,RAWDATA



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	count	Time	count	gain_set1	gain_set2	offset	rawdata	correct	error		Time	Count	RAWDATA
2	399												
3	398												
4	397												
5	396												
6	395												
7	394												
8	393												

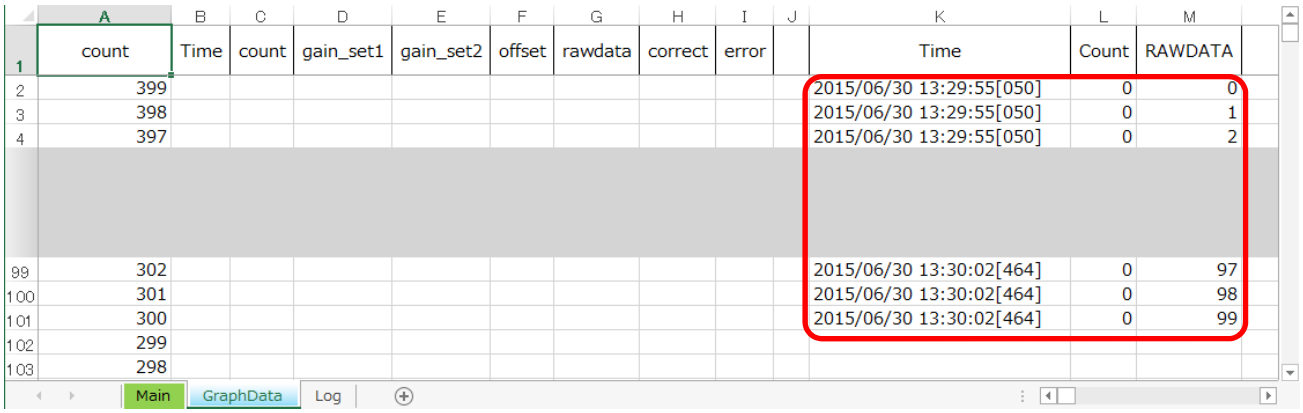
Main GraphData Log

Received data

BULK:0,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19
BULK:0,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39
BULK:0,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59
BULK:0,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79
BULK:0,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99

BULKEND:0

Received data



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	count	Time	count	gain_set1	gain_set2	offset	rawdata	correct	error		Time	Count	RAWDATA
2	399										2015/06/30 13:29:55[050]	0	0
3	398										2015/06/30 13:29:55[050]	0	1
4	397										2015/06/30 13:29:55[050]	0	2
99	302										2015/06/30 13:30:02[464]	0	97
100	301										2015/06/30 13:30:02[464]	0	98
101	300										2015/06/30 13:30:02[464]	0	99
102	299												
103	298												

Main GraphData Log

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Renesas Electronics Website
http://www.renesas.com/

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Revision History

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

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   — 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.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

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.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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