LC717A10

Demo Application Software User's Manual

ON Semiconductor®

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Overview

The document of "LC717A10 Demo Application Software User's Manual" describes the operation method of the LC717A10 demo application software "LC717A10App.exe (Ver.1.2.0)".

Function

- Change/update the settings of the LC717A10
- Read data from the LC717A10 and display them on the monitor

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1. Setup

How to install software

Please copy the LC717A10 demonstration application software executable file "LC717A10App.exe" (hereinafter this is called "the application software") to any folder on your PC.

How to connect the demonstration board to the PC

Firstly, it is necessary to prepare a USB-to Serial conversion module for I^2C (Inter-Integrated Circuit)/ SPI (Serial Peripheral Interface) communication in order to use the application software.

Secondly, connect the conversion module to the LC717A10 demonstration board to communicate each other through I^2C/SPI interface.

Finally, connect the conversion module and the PC, which executes the application software, with USB interface.

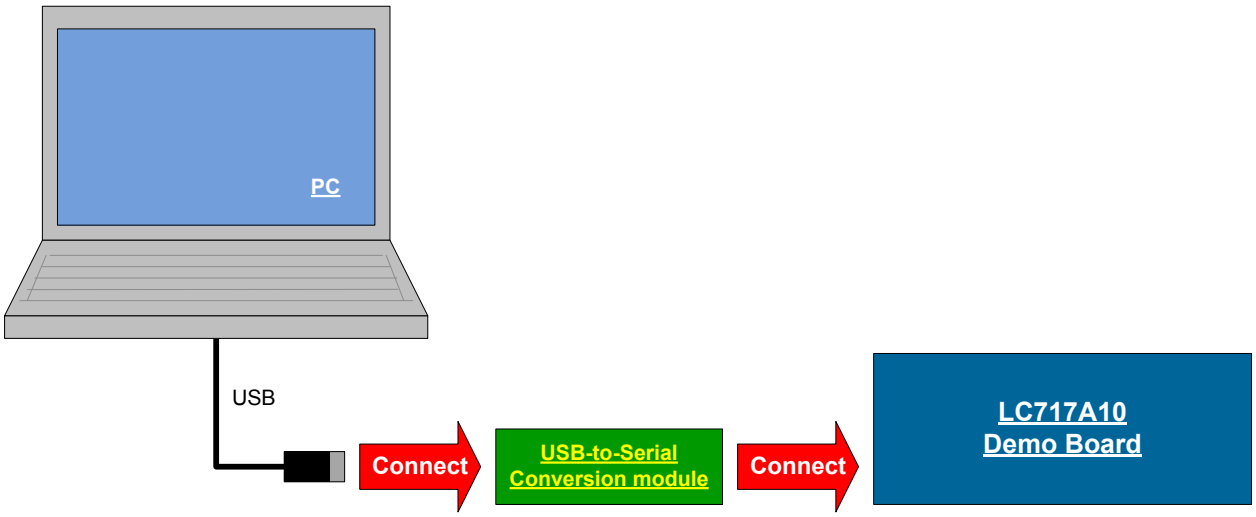

Fig 1.1 How to connect the demonstration board to the personal computer

USB-to-Serial conversion modules for which we have confirmed normal operation are as follows:

- "MM-FT232H" produced by Sunhayato Corp (Japan)
- "C232HM-DDHSL-0" produced by FTDI (Future Technology Devices International Limited, UK)
- "C232HM-EDHSL-0" produced by FTDI (Future Technology Devices International Limited, UK)

Device Driver for the USB-to-Serial conversion modules

You can download D2XX drivers, which are appropriate drivers for the modules, from FTDI's web page. Please download the device driver from the following URL and install it into your PC.

FTDI official web page: http://www.ftdichip.com/

2. How to use the application software

When you double-click on the icon "LC717A10App.exe", the application software starts to run.

When you start the application software on the condition that the LC717A10 demonstration board is correctly connected to your PC, the following windows are displayed.

Fig 2.1

If the LC717A10 demonstration board is incorrectly connected to your PC, the following window is displayed. To put it concretely, some controls on the window (such as "Monitor START" button, "Monitor STOP" button, and so on) are deactivated.

In such a case, you need to exit the application software, and then you restart the application software after you confirm the correct connections between the board and the PC.

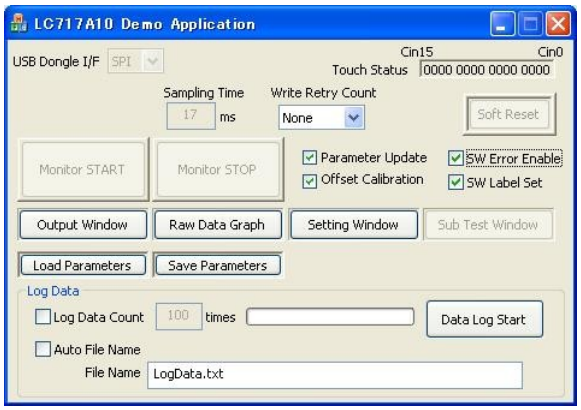

Fig 2.2

2.1. Main window

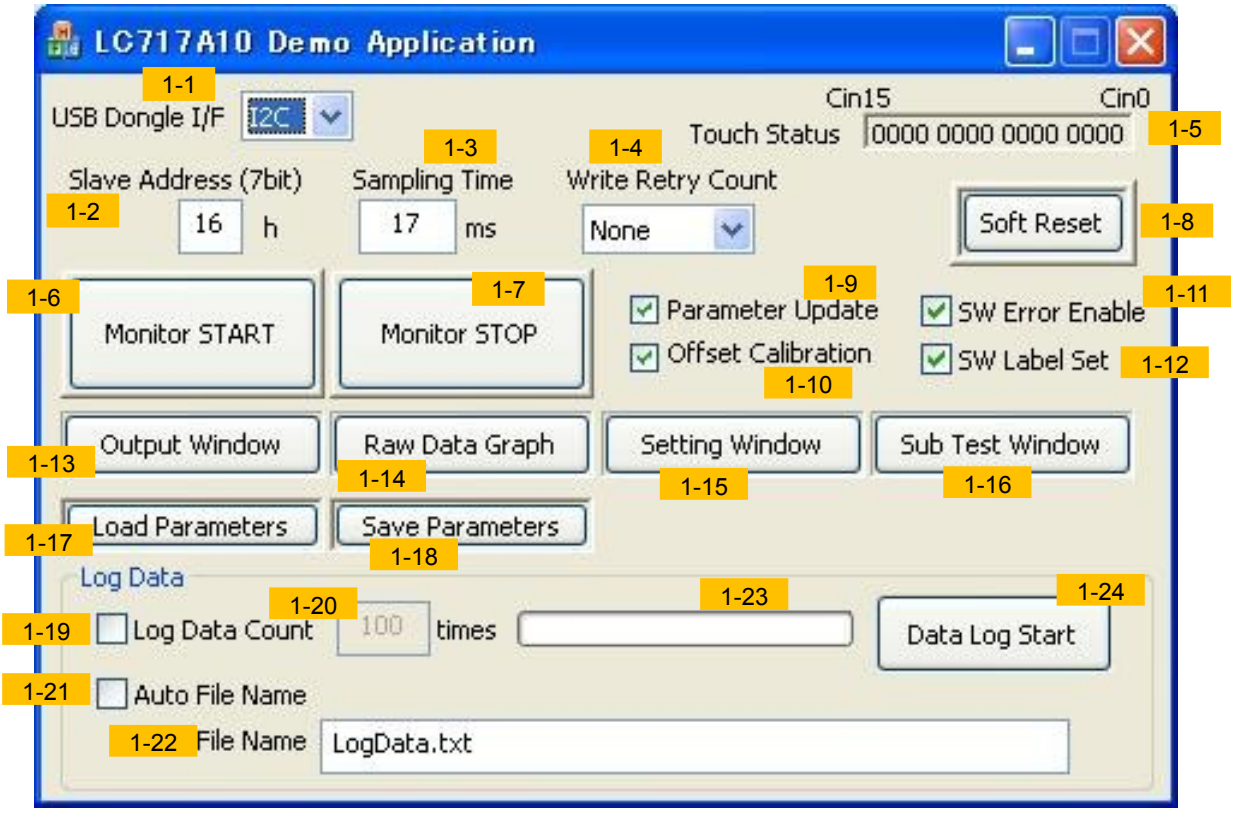

Fig 2.3 Main window

Note: In the following description, "(Address = 0xXX)", which is the string placed after the string of the register name, represents the value of the register address. For example, "the Result Data 1 Register (Address=0x2A)" means that the register address value of the Result Data 1 Register is 0x2A (in hexadecimal format).

[1-1][USB Dongle I/F]

The [1-1] setting is used to select the USB Dongle I/F (I^2C or SPI).

The following is the "Main window" when SPI is selected as the interface between the USB Dongle and the LC717A10.

Fig 2.4

[1-2][Slave Address (7bit)]

The [1-2] setting can specify the LC717A10 I^2C slave address (7bit).

The slave address of the LC717A10 is determined depending on each of 2 pins, SA1 pin and SA0 pin. You have to specify the appropriate LC717A10 I^2C slave address.

the input to SA1 pin	the input to SA0 pin	7bit slave address (in hexadecimal format)
Low	Low	0x16
Low	High	0x17
High	Low	0x18
High	High	0x19

Table 2-1

[1-3][Sampling Time]

The [1-3] setting can specify a time interval for sampling various kinds of data of all the enabled channels in the LC717A10. The unit is milliseconds

"A time interval for sampling various kinds of data of all the enabled channels in the LC717A10" doesn't mean the amount of time that it takes to measure data of all the enabled channels in the LC717A10 (in other words, the measurement-to-measurement time interval). it means the time interval that the application software obtains various kinds of data such as measurement data or touch result information periodically through reading registers from the LC717A10.

The application software reads data periodically from the LC717A10 without considering the data measurement timing in the LC717A10. The time interval at which various kinds of data are read is equal to the time interval specified in the [1-3] setting.

[1-4][Write Retry Count]

The [1-4] setting can specify the sum of 1 and the maximum number of retry when the application software fails in writing to registers of the LC717A10 through I^2C/SPI interface.

The setting values are as follows: "None","1 time","2 times","3 times","4 times","5 times".

For example, when the setting value is "2 times", the application software tries to write some data into the LC717A10 at most 2 times until it writes successfully into a register of the LC717A10. (In other words, Once the application software writes some data into a register of the LC717A10 successfully, it doesn't try to write into the LC717A10 any more.) When the setting value is "None", it writes some data into the LC717A10 only once in spite of the success or failure in writing.

[1-5][Touch Status]

The [1-5][Touch Status] shows the touch judgment result of each Cin, which is indicated by the Result Data 1 Register (Address=0x2A) and the Result Data 2 Register (Address=0x2B), is indicated in binary representation.

Example: A touch status result when touching only Cin0

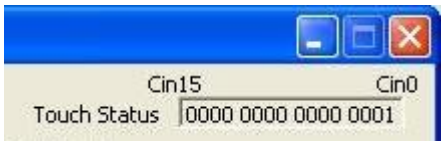

Fig 2.5

*The value of the [1-5][Touch Status] is in binary format. When touching only Cin0, the LSB bit is "1 " and the bits other than the LSB bit are "0".

[1-6][Monitor START] button

When you click on the [1-6] button, the application software starts sampling and monitoring data of the LC717A10. Various kinds of data are obtained from the LC717A10 and displayed periodically on the "Switch result output window (to be described later)" and "Measurement data graph window (to be described later)" according to the sampling time interval as specified in the [1-3][Sampling Time] setting.

To stop the sample monitoring, you have to click on the [1-7][Monitor STOP] button.

The data obtained according to the sampling time interval are CinX measurement data (Address= 0x1A to 0x29), touch result information (Address=0x2A to 0x2B), error status (Address=0x2C) and error channel status (Address=0x2D to 0x2E).

After you click on the [1-6] button, it is deactivated and the [1-7][Monitor STOP] button is activated.

Furthermore, during monitoring, some buttons on the "Main window" are deactivated.

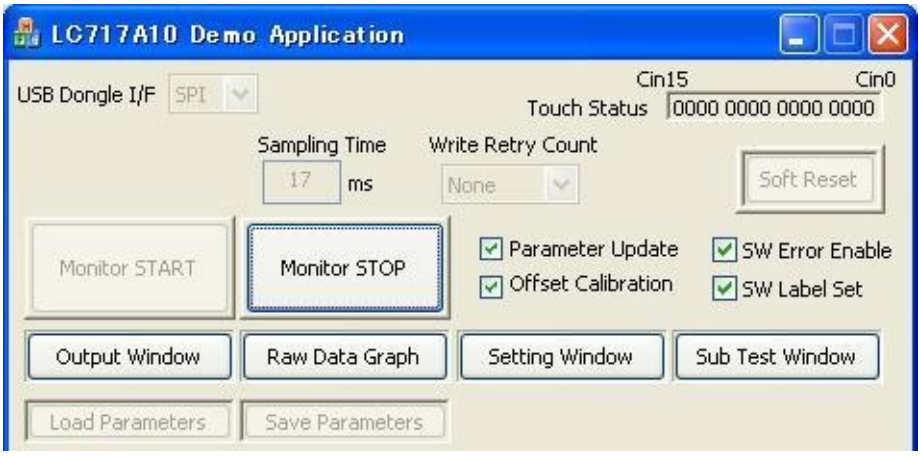

Fig 2.6

[1-7][Monitor STOP] button

When you click on the [1-7] button, the application software stops sampling and monitoring data of the LC717A10.

Note: Only during monitoring (to put it concretely, only when the application software is getting data from the LC717A10), the [1-7] button is being activated. After you click on the [1-7] button, it is deactivated and the [1-6][Monitor START] button is activated.

[1-8][Soft Reset] button

When you click on the [1-8] button, you can software-reset the LC717A10. The application software sets the SoftRst bit in the Control 2 Register (Address=0x40) to "1" in order to software-reset the LC717A10.

[1-9][Parameter Update] checkbox

In the case that the [1-9] checkbox is checked: When you click on the [1-6][Monitor START] button, the application reflects all the setting values on the "Setting window (to be described later)" into the LC717A10, and then it makes the LC717A10 perform static offset calibration only when the [1-10][Offset Calibration] checkbox(to be described later) is checked. Furthermore the application software starts getting data from the LC717A10 and displaying the data on the window such as "Measurement data graph window (to be described later)".

In the case that the [1-9] checkbox is unchecked: When you click on the [1-6][Monitor START] button, the application makes the LC717A10 perform static offset calibration only when the [1-10][Offset Calibration] checkbox(to be described later) is checked, and then it starts getting data from the LC717A10 and displaying the data on the window such as "Measurement data graph window (to be described later)" without reflecting the setting values on the "Setting window" into the LC717A10. Moreover, the color of string "Parameter Update" changes to red.

* : Usually, check the [1-9] checkbox.

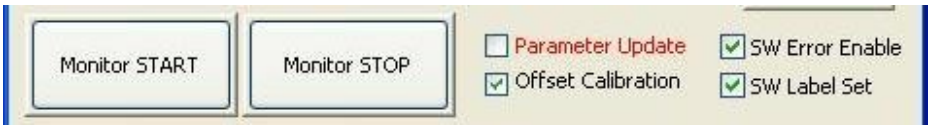

Fig 2.7

[1-10][Offset Calibration] checkbox

In the case that the [1-10] checkbox is checked: When you click on the [1-6][Monitor START] button, the application does or doesn't reflect all the setting values on the "Setting window (to be described later)" into the LC717A10 according to the [1-9][Parameter Update] setting, and then it issues a request to the LC717A10 for performing static offset calibration. Furthermore the application software starts getting data from the LC717A10 and displaying the data on the window such as "Measurement data graph window (to be described later)".

In the case that the [1-10] checkbox is unchecked: When you click on the [1-6][Monitor START] button, the application does or doesn't reflect all the setting values on the "Setting window (to be described later)" into the LC717A10 according to the [1-9][Parameter Update] setting, and then it starts getting data from the LC717A10 and displaying the data on the window such as "Measurement data graph window (to be described later)" without issuing a request to the LC717A10 for performing static offset calibration. Moreover, the color of string "Offset Calibration" changes to red.

*: Usually, check the [1-10] checkbox.

Fig 2.8

[1-11][SW Error Enable] checkbox

In the case that the [1-11] checkbox is checked: When an error (such as a calibration error) occurs in the LC717A10, the error can be displayed on the button display of the "Switch result output window (to be described later)".

In the case that the [1-11] checkbox is unchecked: When an error occurs in the LC717A10, the error is not displayed on the button display of the "Switch result output window (to be described later).

See the description of the "Switch result output window".

Note: "SW" is the abbreviation of "Switch".

[1-12][SW Label Set] checkbox

When the [1-12] checkbox is unchecked, each switch label name of 16-switch images is set as follows: "SW1", "SW2", "SW3",… ,"SW16".

In addition, when the switch status of a SW number has changed from OFF state to ON state, the application software plays the wav file corresponding to the number of the SW if the wav file exists. (The file name of the wav file corresponding to SW6 is ".\wave\TouchSW6.wav", and the file name of the wav file corresponding to SW11 is ".\wave\TouchSW11.wav".)

Fig 2.9

(Usually, 16-switch images are displayed on the "Switch result output window")

When the [1-12] checkbox is checked, each switch label name of 16-switch images is set to the label specified in the content of the setting file whose extension is usually ".prm". If you would like to change the label name, you need to edit the setting file directly. In the setting file, 16 strings under the label "<Switch Label>" correspond to the switch label name of "SW1" to "SW16". (Especially, in the window shown below, the 8 strings are "Cin0", "Cin1",…, "Cin15".)

In addition, when the switch status of a SW number has changed from OFF state to ON state, the application software plays the wav file corresponding to the number of the SW if the wav file exists. (The file name of the wav file corresponding to SW4 is ".\wave\TouchSW4.wav", and the file name of the wave file corresponding to SW13 is ".\wave\TouchSW13.wav".)

Fig 2.10

(Usually, 16-switch images are displayed on the "Switch result output window")

[1-13][Output Window] button

When you click on the [1-13] button, the "Switch result output window (to be described later)" is displayed. (It is the default setting for the application software).

[1-14][Raw Data Graph] button

When you click on the [1-14] button, the "Measurement data graph window (to be described later)" is displayed.

[1-15][Setting Window] button

When you click on the [1-15] button, the "Setting window (to be described later)" is displayed.

[1-16][Sub Test Window] button

When you click on the [1-16] button, the "Sub test window (to be described later)" is displayed.

[1-17][Load Parameters] button

If you select the file into which you saved all the settings of the application software(The extension of the file is usually ".prm"), the application software loads the settings from the file and reflected into the application software.

[1-18][Save Parameters] button

You can save the current settings of the application software with a specified file name.
The extension of the file into which you save the settings is usually ".prm".

[1-19][Log Data Count] checkbox

When the [1-19] checkbox is checked, the number of logging data can be specified. When you click on the [1-24][Data Log Start] button (to be described later), the application software stops logging data automatically after logging data for the specified number.

When the [1-19] checkbox is unchecked, the number of logging data can't be specified. To stop logging data, you have to click on the [1-24][Data Log Start] button (to be described later).

[1-20][The number of data logging]

Only when the [1-19][Log Data Count] checkbox is checked, the number of logging data can be specified.

When the [1-19][Log Data Count] checkbox is unchecked, the [1-20] setting is unavailable.

[1-21][Auto File Name] checkbox

When the [1-21] checkbox is checked, a file which keeps log data is newly generated automatically at the beginning of logging data. (In other words, as soon as you click on the [1-24][Data Log Start] button (to be described later) a log data file is newly created automatically.)

The file name is "LogDataYYYYMMDDXXXXXXX.txt", where "YYYYMMDD" is year-month-day, "XXXXXXX" is serial number.

When the [1-21] checkbox is unchecked, you need to specify a file name which keeps log data.

[1-22][File Name]

When the [1-21][Auto File Name] checkbox is unchecked, the name of the file which keeps log data can be set. The default file name is "LogData.txt".

When the [1-21][Auto File Name] checkbox is checked, the [1-22] setting is unavailable.

[1-23][Progress of data log acquisition process]

When the [1-19][Log Data Count] checkbox is checked, the application software displays the progress of data log acquisition processing while it is obtaining data log with a specified number of logging data.

When the [1-19][Log Data Count] checkbox is unchecked, the progress is not displayed.

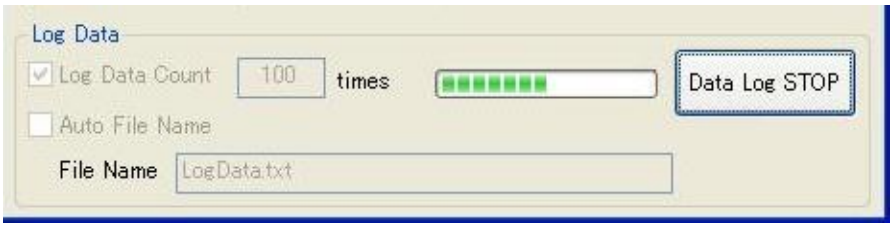

Fig 2.11

[1-24][Data Log Start] button / [Data Log STOP] button

When you click on the [1-24][Data Log Start] button, the application software starts saving log data to the specified file. During logging, the caption of the button changes to "Data Log STOP".

If you click on the [1-24][Data Log STOP] button, the application software stops logging data. And then, the caption of the button changes back to "Data Log Start".

2.2. Switch result output window

Channel Cin0 to Cin7 correspond to switch SW1 to SW8 respectively.

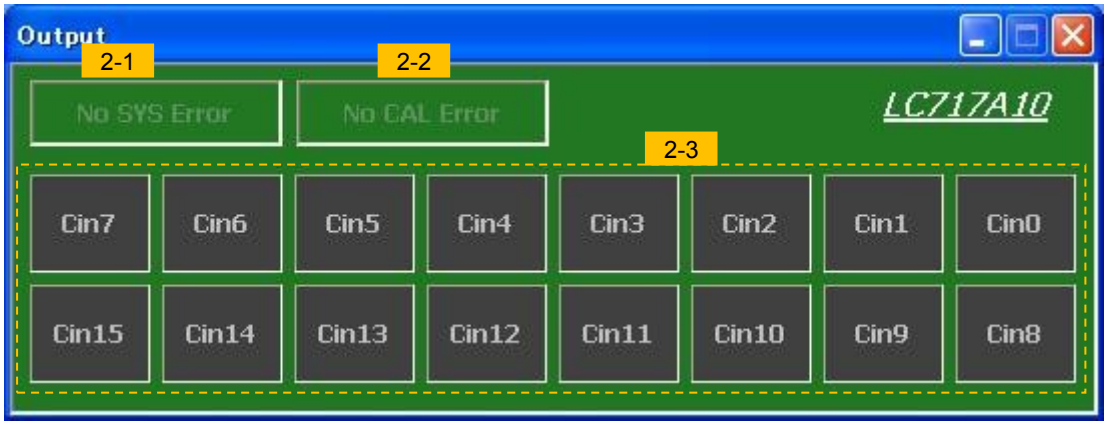

Fig 2.12 Switch result output window

[2-1][System error display]

The status of the system error (the SYSERR bit in the Error Status Register(Address=0x2C)) of the LC717A10 is displayed on the [2-1][System error display].

- No SYS Error: No system error
- SYS Error: the system error occurred

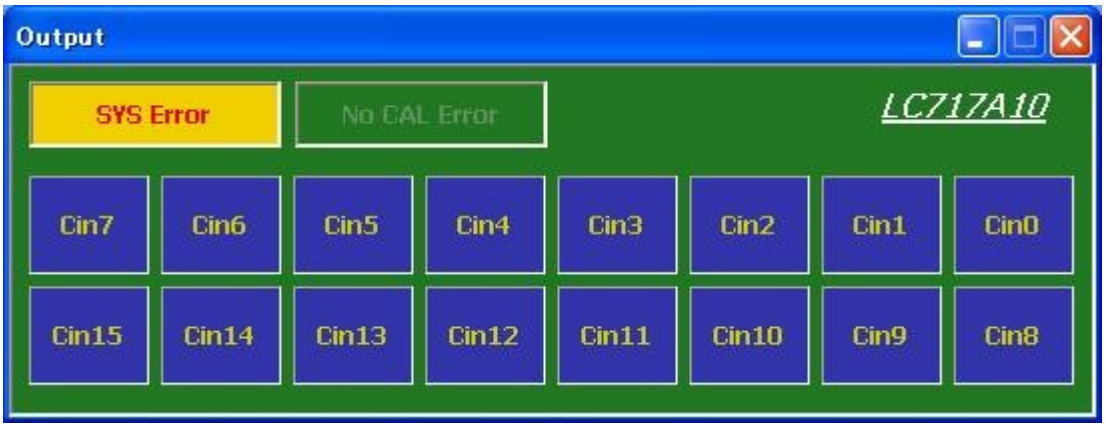

Fig 2.13

[2-2][Calibration error display]

The status of the calibration error (the CALERR bit in the Error Status Register (Address=0x2C)) of the LC717A10 is displayed on the [2-2][Calibration error display].

- No CAL Error: No calibration error
- CAL Error: Calibration error occurred

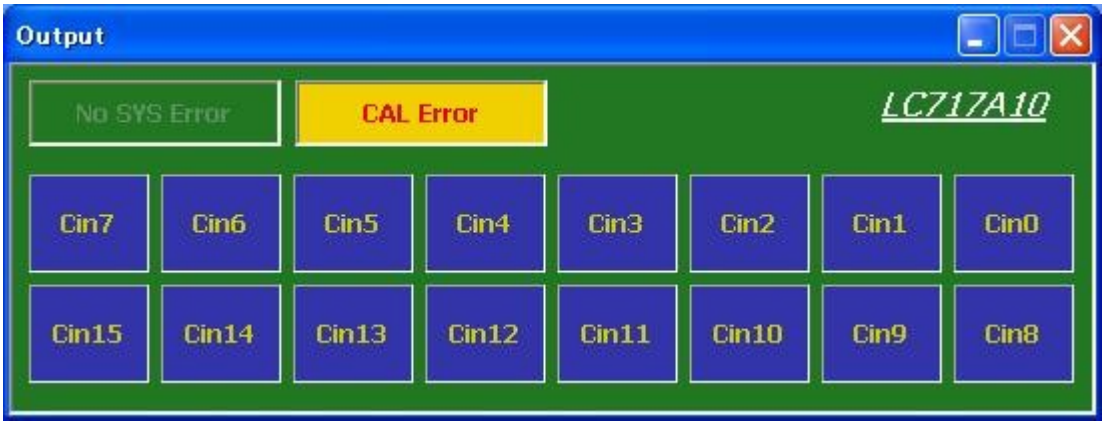

Fig 2.14

[2-3][Switch state display]

The status of each switch during monitoring is displayed on the [2-3][Switch state display].

When the [1-11][SW Error Enable] checkbox is unchecked in the "Main window", the color of each button image changes depending only on the status of each switch (the Result Data 1 Register (Address=0x2A) and the Result Data 2 Register (Address=0x2B)).

- Blue: No touch
- Red: Touched

When the [1-11][SW Error Enable] checkbox is checked, the color of each button image changes depending not only on the status of each switch but also on the error information of the error channel status (the Error Channel Status 1 Register (Address=0x2D) and the Error Channel Status 2 Register (Address=0x2E))

- Blue: No touch
- Red: Touched
- Yellow: With a calibration error

Fig 2.15 Example 1:The case that only Cin8 is touched

Fig 2.16 Example 2: The case that only Cin8 is touched and a calibration error occurs at Cin0
(Only when the [1-11][SW Error Enable] checkbox is checked)

2.3. Measurement data graph window

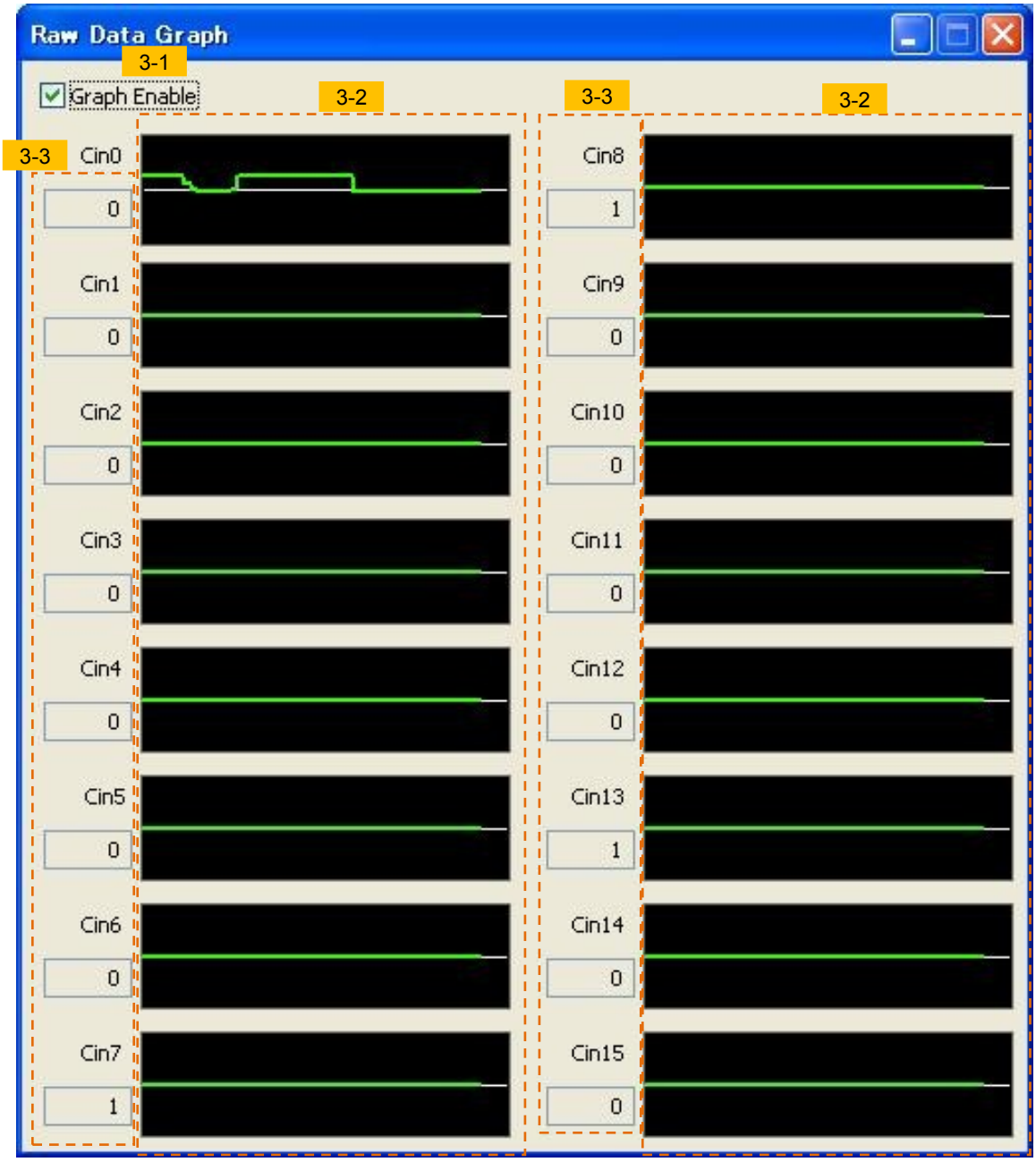

Fig 2.17 Measurement data graph window
(The case that only Cin0 is touched and released
and all CinX's other than Cin0 are untouched)

[3-1][Graph Enable] checkbox

When the [3-1] checkbox is checked, the graph of measurement data of all the sixteen channels of the LC717A10 is displayed.

When the [3-1] checkbox is unchecked, the graph of measurement data is not displayed.

[3-2][Measurement data graph]

The graph of measurement data of each channel is displayed on the [3-2][Measurement data graph].
The line color is green. The range of the vertical axis in each graph is -128 to 127.

[3-3][Measurement data]

The value of measurement data of each channel is displayed on the [3-3][Measurement data].
The value is in decimal format.

2.4. Setting window

2.4.1. Normal Setting Mode

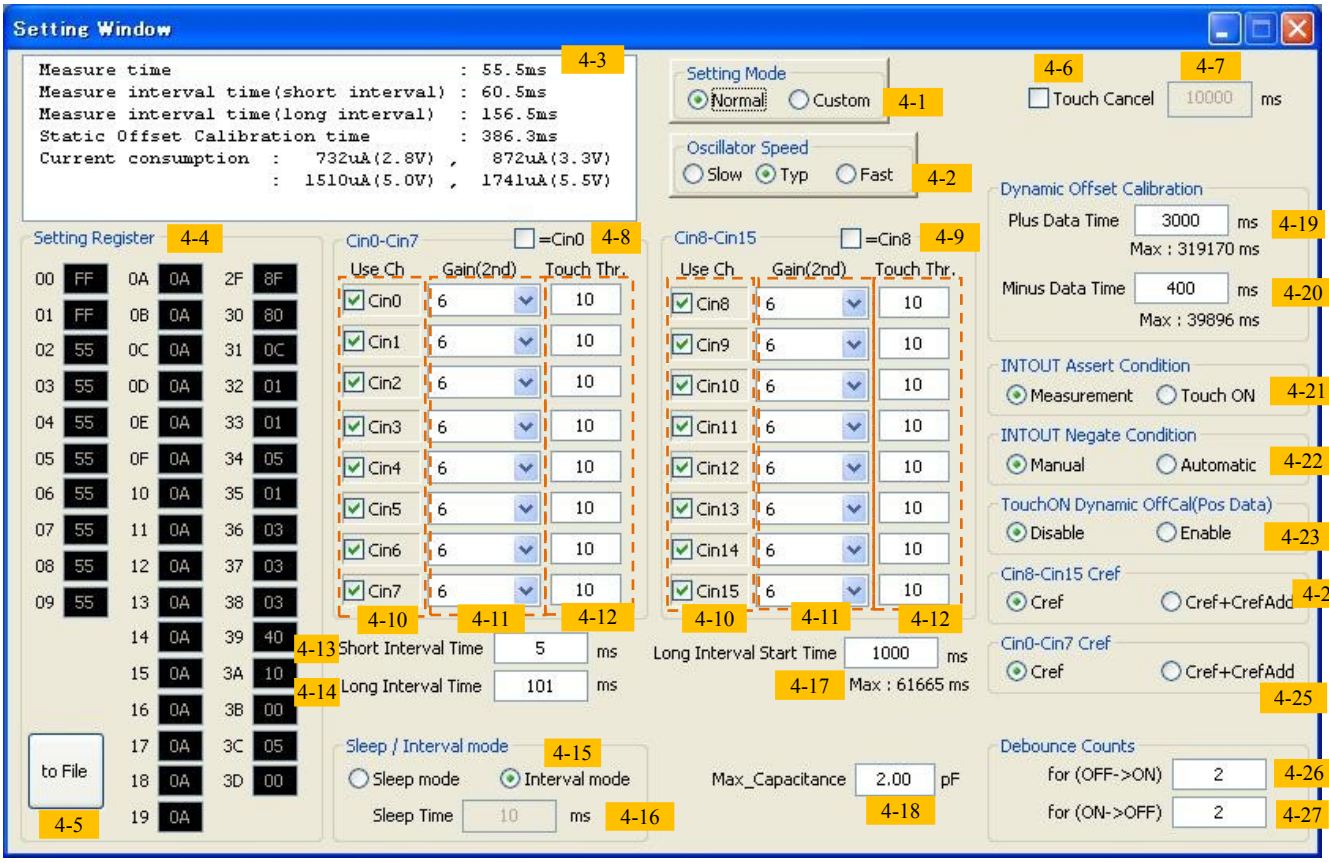

Fig 2.18 Setting window (Normal Setting Mode)

[4-1][Setting Mode]

The [4-1] setting is used to select the setting mode for specifying various kinds of settings. The application software has two setting modes. When you select "Normal", the setting mode is "Normal setting mode". On the other hand, when you select "Custom", the setting mode is "Custom setting mode". The "Custom setting mode" enables you to specify more settings than the "Normal setting".

The section of "2.4.1 Normal Setting Mode" explains the case where the "Normal" is selected.

[4-2][Oscillator Speed]

The [4-2] setting is used to select the speed of operating frequency of the LC717A10. To put it concretely, the application software uses the [4-2] setting to calculate either the time-related values (such as measurement time of all the enabled channels (excluding the short interval time or long interval time), static-offset-calibration-time of all the enabled channels) or the register setting values related to time. If you change the [4-2] setting, some of the values in hexadecimal notation on the [4-4][Setting Register] area will be changed.

Slow : The value of the oscillation frequency of the RC oscillator of the LC717A10 is the minimum value. To say in other words, the speed of operating frequency of the LC717A10 is slow.

Typ: The value of the oscillation frequency of the RC oscillator of the LC717A10 is a typical value. To say in other words, the speed of operating frequency of the LC717A10 is typical.

Fast : The value of the oscillation frequency of the RC oscillator of the LC717A10 is the maximum value. To say in other words, the speed of operating frequency of the LC717A10 is fast.

[4-3][Various calculation results]

On the [4-3][Various calculation results] area, the application software displays the measurement time of all the enabled channels (excluding the time interval such as "short interval time" or "long interval time"), measurement-to- measurement time in the short interval mode, measurement-to- measurement time in the long interval mode, static offset calibration time of all the enabled channels, and current consumption, which the application software calculates from the current settings on the "Setting window".

The static offset calibration time which is shown on the [4-3] area is the time which it takes for the LC717A10 to perform the static offset calibration only once. Actually, as the LC717A10 tries static offset calibration at most three times (until static offset calibration has succeeded), the maximum value of the static-offset-calibration-time may be 3 times as large as the value of the static-offset- calibration time which is shown on the [4-3] area.

[4-4][Setting Register]

The application shows the register setting values on the [4-4][Setting Register] area, which are dependent on the current configurations on the "Setting window".

Every time you change any setting on the "Setting window", some of the register setting values shown on the [4-4] area will be changed according to the settings on the "Setting window".

[4-5][to File] button

When you click on the [4-5] button, the application software saves the register setting values shown on the [4-4][Setting Register] area into the file named "LC717A10Reg.txt", which is in a text file format.

[4-6][Touch Cancel] checkbox

When the [4-6] checkbox is checked, "touch-cancellation" function is enabled. The touch-cancellation function is the function for the application software to request the static offset calibration to the LC717A10 automatically only when the touch detection results, which are indicated by the Result Data 1 Register (Address=0x2A) and the Result Data 2 Register (Address=0x2B), aren't all zero and the touch detection results have not changed for the long time specified in the [4-7][Touch cancel time] setting.

When the [4-6] checkbox is unchecked, "touch-cancellation" function is disabled.

[4-7][Touch cancel time]

Only when the [4-6][Touch Cancel] checkbox is checked, you can specify the timeout period of the "touch–cancellation" function. The timeout period is the parameter required for the application software to perform the "touch-cancellation" function.

When the [4-6][Touch Cancel] checkbox is unchecked, the [4-7] setting is unavailable.

[4-8][=Cin0] checkbox

In the case that the [4-8] checkbox is checked: If you change either the [4-11][Gain(2nd)] of Cin0 or the [4-12][Touch Thr.] of Cin0, the gain/threshold settings from Cin1 to Cin7 will be the same value as those of Cin0.

In the case that the [4-8] checkbox is unchecked: Even if you change either the [4-11][Gain(2nd)] of Cin0 or the [4-12][Touch Thr.] of Cin0, the gain/threshold settings of Cin0 aren't copied to those of Cin1 to Cin7.

Fig 2.19

[4-9][=Cin8] checkbox

In the case that the [4-9] checkbox is checked: If you change either the [4-11][Gain(2nd)] of Cin8 or the [4-12][Touch Thr.] of Cin8, the gain/threshold settings from Cin9 to Cin15 will be the same value as those of Cin8.

In the case that the [4-9] checkbox is unchecked: Even if you change either the [4-11][Gain(2nd)] of Cin8 or the [4-12][Touch Thr.] of Cin8, the gain/threshold settings of Cin8 aren't copied to those of Cin9 to Cin15.

Fig 2.20

[4-10][Use Chn] checkbox

Each of the [4-10] settings is used to enable or disable each Cin.

When you check at least one of the [4-10] checkboxes, the Cin corresponding to the checked checkbox is enabled. In other words, the channel (Cin) corresponding to the unchecked checkbox is measured.

When you uncheck at least one of the [4-10] checkboxes, the Cin corresponding to the unchecked checkbox is disabled. In other words, the channel (Cin) corresponding to the unchecked checkbox is not measured.

- Corresponding register: the Use Channel 1/2 Register (Address=0x00 to 0x01).

[4-11][Gain(2nd)] checkbox

Each of the [4-11] settings can specify the gain of the 2nd amplifier for each Cin. The unit is times.

You can specify the gain of the 2nd amplifier for each Cin individually.

The setting values are as follows: "1","2","3","4","5","6","7","8","9","10","11","12" "13","14","15","16".

- Corresponding register: the CinX 2nd Gain Register (Address=0x02 to 0x09).

[4-12][Touch Thr.]

Each of the [4-12] settings can specify the threshold for touch ON/OFF decision for each Cin.

You can specify the threshold for touch ON/OFF decision for each Cin individually.

- Corresponding register: the CinX Threshold Register (Address=0x0A to 0x19).

[4-13][Short Interval Time]

The [4-13] setting can specify short interval time (interval time in short interval mode). The unit is milliseconds.

- Corresponding register: the Short Interval Time Register (Address=0x34).

[4-14][Long Interval Time]

The [4-14] setting can specify long interval time (interval time in long interval mode). The unit is milliseconds.

- Corresponding register: the Long Interval Time Register (Address=0x35).
- Corresponding register: the LIVALB bit in the Measurement Mode 1 Register (Address=0x3A).

[4-15][Sleep/Interval mode]

The [4-15] setting is used to select the operation mode of the LC717A10 from either the sleep mode or the interval mode.

- Corresponding register: the IntMode bit in the Control 1 Register (Address=0x2F)

[4-16] Sleep/Interval mode [Sleep Time]

You can specify the "provisional" sleep time value used for calculation of the time-related values such as the measurement time of all the enabled channels. The [4-16] setting is valid for only when selecting the sleep mode.

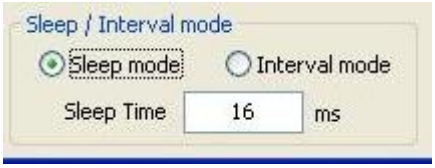

Fig 2.21

[4-17][Long Interval Start Time]

The [4-17] setting specifies the long interval start time. The long interval start time means the time from the time when all the enabled channels are in a non-touch state until the LC717A10 moves to long interval mode. To say precisely, only when you don't touch a certain channel until the long interval start time specified in the [4-17] setting passes after all the enabled channels have become in a non-touch state, the LC717A10 moves to long interval mode.

The "Max : xxxms", which is shown below the [4-17] setting, is the maximum value of long interval start time calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" to the [4-17] setting.

- Corresponding register: the Long Interval Mode Start Count Register (Address=0x3C).

[4-18][Static OffCal CDAC Base]

The [4-18] setting can specify the maximum capacitance value in all the enabled channels. Automatically, the application software determines the static offset calibration CDAC base by using the value specified in the [4-18] setting.

If you don't know the maximum capacitance, you should specify the 4.00pF as a setting value of the [4-18].

□ Corresponding register: the Static OffCal CDAC Base Register (Address=0x39).

[4-19] Dynamic Offset Calibration [Plus Data Time]

The [4-19] setting can specify the dynamic offset calibration time for the positive range of measurement data.

Automatically, the application software calculates and determines the setting value for the Dynamic OffCal Time Plus Register (Address=0x37). If the number of consecutive judgment points that measurement data is consecutively within the positive range(4 to threshold) for dynamic offset calibration at the consecutive judgment timings becomes equal to the value of the "dynamic-offset -calibration-execution counts" which is specified by the Dynamic OffCal Time Plus Register (Address=0x37), dynamic offset calibration is automatically performed. Note that the value of the "dynamic-offset- calibration-execution counts" equals 8 times the value which is specified by the Dynamic OffCal Time Plus Register (Address=0x37).

The "Max : xxxms", which is shown below the [4-19] setting, is the maximum value of the dynamic offset calibration time for the positive range of measurement data, which is calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" as a setting value of the [4-19].

□ Corresponding register: the Dynamic OffCal Time Plus Register (Address=0x37).

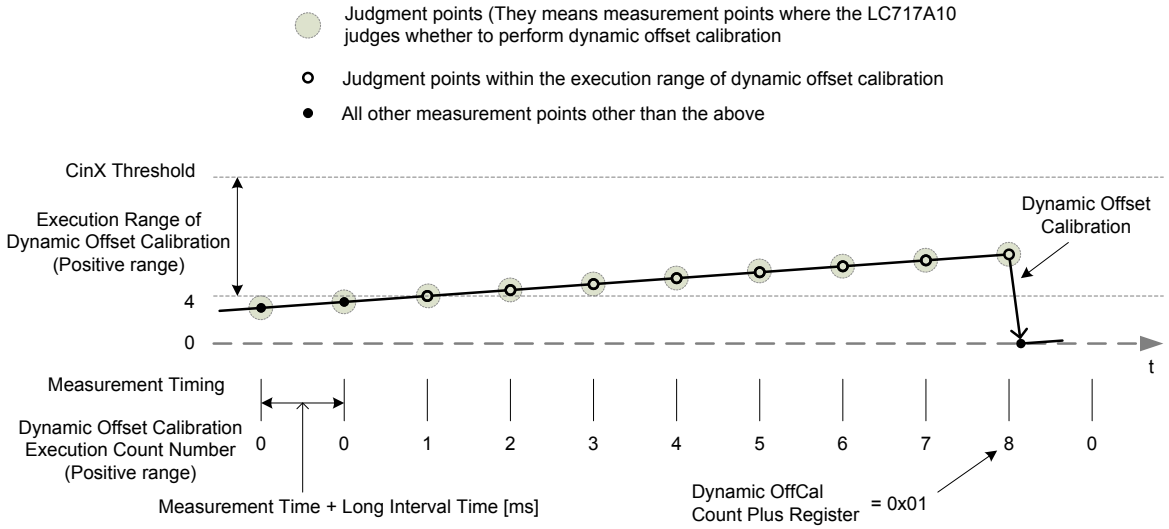

Fig 2.22 Dynamic offset calibration for the positive range during long interval mode (In the case that the setting value of the Dynamic Offcal Count Plus Register is 0x01. About the detail, please refer to the Application Note (another document).)

[4-20] Dynamic Offset Calibration [Minus Data Time]

The [4-20] setting can specify the dynamic offset calibration time for the negative range of measurement data. Automatically, the application software calculates and determines the setting value for the Dynamic OffCal Time Minus Register (Address=0x38). If the number of consecutive judgment points that measurement data is consecutively within the negative range(-128 to -4) for dynamic offset calibration at the consecutive judgment timings becomes equal to the value of the "dynamic-offset -calibration-execution counts" which is specified by the Dynamic OffCal Time Minus Register (Address=0x38), dynamic offset calibration is automatically performed. Note that the value of the "dynamic-offset- calibration-execution counts" equals the value which is specified by the Dynamic OffCal Time Minus Register (Address=0x38]).

The "Max : xxxms", which is shown below the [4-20] setting, is the maximum value of the dynamic offset calibration time for the negative range of measurement data, which is calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" as a setting value of the [4-20].

- Corresponding register: the Dynamic OffCal Time Minus Register (Address=0x38).

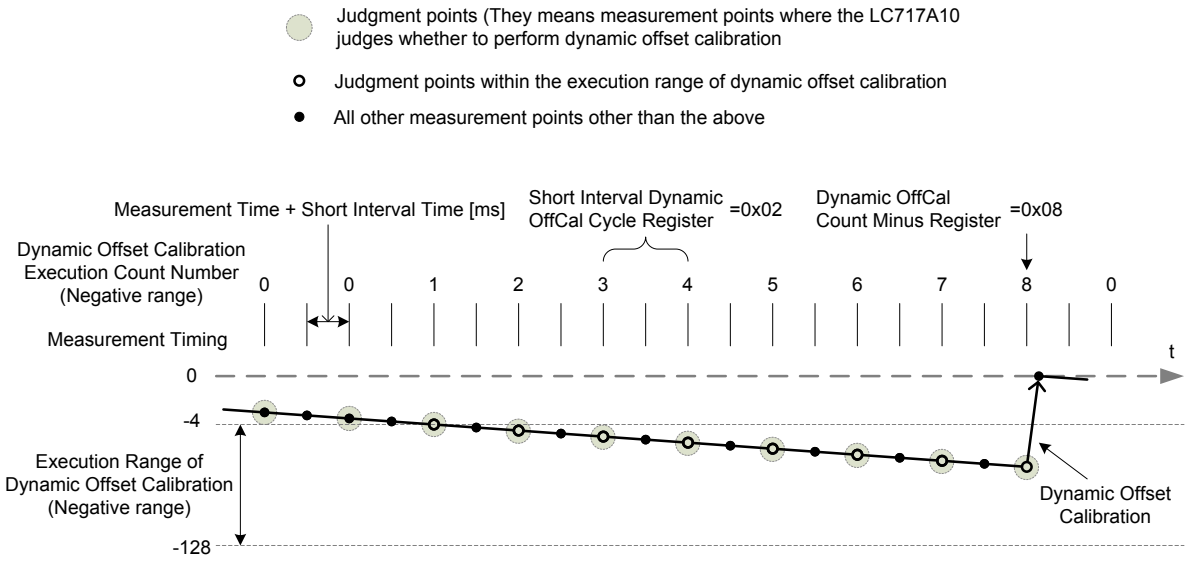

Fig 2.23 Dynamic offset calibration for the negative range during short interval mode (In the case that the setting value of the Short Interval Dynamic Offcal Cycle Register is 0x02 and the setting value of the Dynamic Offcal Count Minus Register is 0x08. About the detail, please refer to the Application Note (another document).)

[4-21][INTOUT Assert Condition]

The [4-21] setting is used to select the condition for asserting the INTOUT.

When you select "Measurement", the INTOUT is asserted at the timing that the measurement of all the enabled channels has completed in the LC717A10.

On the other hand, when you select "Touch ON", the INTOUT is asserted only at the timing that the measurement of all the enabled channels has completed in the LC717A10 and touching ON are detected at one or more channels of the LC717A10.

- Corresponding register: the INTMD1 bit in the Measurement Mode 1 Register (Address=0x3A).

[4-22][INTOUT Negate Condition]

The [4-22] setting is used to select the condition for negating the INTOUT.

When "Manual" is selected, the INTOUT isn't negated automatically.

When "Automatic" is selected, the INTOUT is always negated automatically either at the end of interval processing (in the case of interval mode) or at the wake-up of the LC717A10 (in the case of sleep mode).

When the INTOUT is asserted, INTOUT output level is "High". On the other hand, when it is negated, the INTOUT output level is "Low".

 Corresponding register: the INTMD2 bit in the Measurement Mode 1 Register (Address=0x3A).

[4-23][TouchON Dynamic OffCal(Plus Data)]

The [4-23] setting is used to select the dynamic offset calibration method for the positive range of measurement data.

In the case that "Disable" is selected: When one or more channels are in "Touch ON" state, the LC717A10 doesn't perform the dynamic offset calibration for the positive range of measurement data at all the enabled channels.

In the case that "Enable" is selected: When one or more channels are in "Touch ON" state, the LC717A10 performs the dynamic offset calibration for the positive range of measurement data at all the enabled channels other than the "Touch-ON-state" channels.

 Corresponding register: the PDCLP bit in Measurement Mode 1 Register (Address=0x3A).

[4-24][Cin8-Cin15 Cref]

The [4-24] setting is used to select the port the LC717A10 connects as a differential pair when the LC717A10 measures Cin8 to Cin15.

When "Cref" is selected, the port used as a differential pair is Cref when the LC717A10 measures Cin8 to Cin15.

When "Cref+CrefAdd" is selected, the ports used as a differential pair are both Cref and CrefAdd (combinations of two capacitors) when the LC717A10 measures Cin8 to Cin15.

 Corresponding register: the CIN8CINP2 bit in the Measurement Mode 2 Register (Address=0x3B).

[4-25][Cin0-Cin7 Cref]

The [4-25] setting is used to select the port the LC717A10 connects as a differential pair when the LC717A10 measures Cin0 to Cin7.

When "Cref" is selected, the port used as a differential pair is Cref when the LC717A10 measures Cin0 to Cin7.

When "Cref+CrefAdd" is selected, the ports used as a differential pair are both Cref and CrefAdd (combinations of two capacitors) when the LC717A10 measures Cin0 to Cin7.

 Corresponding register: the CIN0CINP2 bit in the Measurement Mode 2 Register (Address=0x3B).

[4-26][Debounce Count for (OFF->ON)]

The [4-26] setting can specify the de-bounce count which is used for decision of Touch "OFF". In other words, the LC717A10 uses the [4-26] setting when the touch status of each enabled channel changes from ON state to OFF state.

- Corresponding register: the Debounce Count 1 Register (Address=0x32).

[4-27][Debounce Count for (ON->OFF)]

The [4-27] setting can specify the de-bounce count which is used for decision of Touch "ON". In other words, the LC717A10 uses the [4-27] setting when the touch status of each enabled channel changes from OFF state to ON state.

- Corresponding register: the Debounce Count 2 Register (Address=0x33).

2.4.2. Custom Setting Mode

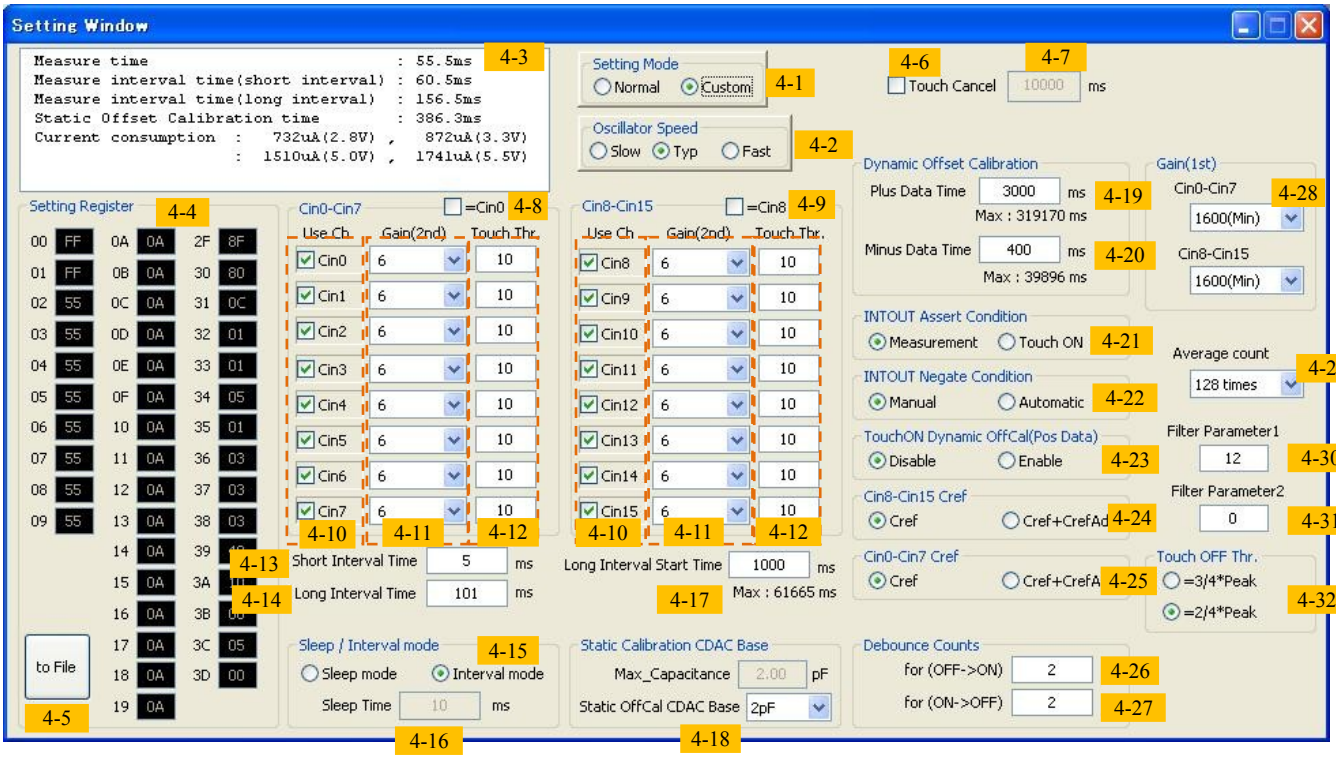

Fig 2.24 Setting window (Custom Setting Mode)

* Usually, please use the "Normal Setting Mode".
If you change some settings which are specific to the "Custom Setting Mode", noise immunity may be reduced. Please change the settings based on sufficient verification.

[4-1][Setting Mode]

The [4-1] setting is used to select the setting mode for specifying various kinds of settings. The application software has two setting modes. When you select "Normal", the setting mode is "Normal setting mode". On the other hand, when you select "Custom", the setting mode is "Custom setting mode". The "Custom setting mode" enables you to specify more settings than the "Normal setting".

The section of "2.4.2 Custom Setting Mode" explains the case where the "Custom" is selected.

[4-2][Oscillator Speed]

The [4-2] setting is used to select the speed of operating frequency of the LC717A10. To put it concretely, it is used to calculate either the time-related values (such as measurement time of all the enabled channels (excluding the short interval time or long interval time), static-offset-calibration-time of all the enabled channels) or the register setting values related to time. If you change the [4-2] setting, some of the values (in hexadecimal notation) on the [4-4][Setting Register] area will be changed.

If you don't know which checkbox to select, please specify "Typ".

Slow : The oscillation frequency of the RC oscillator of the LC717A10 is at minimum.

Typ: The oscillation frequency of the RC oscillator of the LC717A10 is typical.

Fast : The oscillation frequency of the RC oscillator of the LC717A10 is at maximum.

[4-3][Various calculation results]

On the [4-3][Various calculation results] area, the application software displays the approximate measurement time of all the enabled channels (excluding the time interval such as "short interval time" or "long interval time"), the approximate measurement-to-measurement time in the short interval mode, the approximate measurement-to-measurement time in the long interval mode, the approximate static offset calibration time of all the enabled channels, and the approximate current consumption, which are all calculated from the current settings on the "Setting window".

The static offset calibration time which is shown on the [4-3] area is the time which it takes for the LC717A10 to perform the static offset calibration only once. Actually, as the LC717A10 performs static offset calibration at most three times (until static offset calibration has succeeded), the approximate maximum value of the static-offset-calibration time may be 3 times as large as the value of the static-offset-calibration time which is shown on the [4-3] area.

[4-4][Setting Register]

The application shows the register setting values on the [4-4][Setting Register] area, which are dependent on the current configurations on the "Setting window".

Every time you change any setting on the "Setting window", some of the register setting values shown on the [4-4] area will be changed according to the settings on the "Setting window".

[4-5][to File] button

When you click on the [4-5] button, the application software saves the register setting values shown on the [4-4][Setting Register] area into the file named "LC717A10Reg.txt", which is in a text file format.

[4-6][Touch Cancel] checkbox

When the [4-6] checkbox is checked, "touch-cancellation" function is enabled. The touch-cancellation function is the function for the application software to request the static offset calibration to the LC717A10 automatically only when the touch detection results, which are indicated by the Result Data 1 Register (Address=0x2A) and the Result Data 2 Register (Address=0x2B), aren't all zero and the touch detection results have not changed for the long time specified in the [4-7][Touch cancel time] setting.

When the [4-6] checkbox is unchecked, "touch-cancellation" function is disabled.

[4-7][Touch cancel time]

Only when the [4-6][Touch Cancel] checkbox is checked, you can specify the timeout period of the "touch–cancellation" function. The timeout period is the parameter required for the application software to perform the "touch-cancellation" function.

When the [4-6][Touch Cancel] checkbox is unchecked, the [4-7] setting is unavailable.

[4-8][=Cin0] checkbox

In the case that the [4-8] checkbox is checked: If you change either the [4-11][Gain(2nd)] of Cin0 or the [4-12][Touch Thr.] of Cin0, the gain/threshold settings from Cin1 to Cin7 will be the same value as those of Cin0.

In the case that the [4-8] checkbox is unchecked: Even if you change either the [4-11][Gain(2nd)] of Cin0 or the [4-12][Touch Thr.] of Cin0, the gain/threshold settings of Cin0 aren't copied to those of Cin1 to Cin7.

Fig 2.25

[4-9][=Cin8] checkbox

In the case that the [4-9] checkbox is checked: If you change either the [4-11][Gain(2nd)] of Cin8 or the [4-12][Touch Thr.] of Cin8, the gain/threshold settings from Cin9 to Cin15 will be the same value as those of Cin8.

In the case that the [4-9] checkbox is unchecked: Even if you change either the [4-11][Gain(2nd)] of Cin8 or the [4-12][Touch Thr.] of Cin8, the gain/threshold settings of Cin8 aren't copied to those of Cin9 to Cin15.

Fig 2.26

[4-10][Use Chn] checkbox

Each of the [4-10] settings is used to enable or disable each Cin.

When you check at least one of the [4-10] checkboxes, the Cin corresponding to the checked checkbox is enabled. In other words, the channel (Cin) corresponding to the unchecked checkbox is measured.

When you uncheck at least one of the [4-10] checkboxes, the Cin corresponding to the unchecked checkbox is disabled. In other words, the channel (Cin) corresponding to the unchecked checkbox is not measured.

- Corresponding register: the Use Channel 1/2 Register (Address=0x00 to 0x01).

[4-11][Gain(2nd)] checkbox

Each of the [4-11] settings can specify the gain of the 2nd amplifier for each Cin. The unit is times.

You can specify the gain of the 2nd amplifier for each Cin individually.

- Corresponding register: the CinX 2nd Gain Register (Address=0x02 to 0x09).

[4-12][Touch Thr.]

Each of the [4-12] settings can specify the threshold for touch ON/OFF decision for each Cin.
You can specify the threshold for touch ON/OFF decision for each Cin individually.

- Corresponding register: the CinX Threshold Register (Address=0x0A to 0x19).

[4-13][Short Interval Time]

The [4-13] setting can specify short interval time (interval time in short interval mode). The unit is milliseconds.

- Corresponding register: the Short Interval Time Register (Address=0x34).

[4-14][Long Interval Time]

The [4-14] setting can specify long interval time (interval time in long interval mode). The unit is milliseconds.

- Corresponding register: the Long Interval Time Register (Address=0x35).
- Corresponding register: the LIVALB bit in the Measurement Mode 1 Register (Address=0x3A).

[4-15][Sleep/Interval mode]

The [4-15] setting is used to select the operation mode of the LC717A10 from either the sleep mode or the interval mode.

- Corresponding register: the IntMode bit in the Control 1 Register (Address=0x2F)

[4-16] Sleep/Interval mode [Sleep Time]

You can specify the "provisional" sleep time value used for calculation of the time-related values such as the measurement time of all the enabled channels. The [4-16] setting is valid for only when selecting the sleep mode.

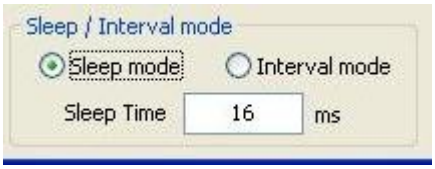

Fig 2.27

[4-17][Long Interval Start Time]

The [4-17] setting specifies the long interval start time. The long interval start time means the time from the time when all the enabled channels are in a non-touch state until the LC717A10 moves to long interval mode. To say precisely, only when you don't touch a certain channel until the long interval start time specified in the [4-17] setting passes after all the enabled channels have become in a non-touch state, the LC717A10 moves to long interval mode.

The "Max : xxxms", which is shown below the [4-17] setting, is the maximum value of long interval start time calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" to the [4-17] setting.

- Corresponding register: the Long Interval Mode Start Count Register (Address=0x3C).

[4-18][Static OffCal CDAC Base]

The [4-18] setting can specify the maximum capacitance value in all the enabled channels. Automatically, the application software determines the static offset calibration CDAC base by using the value specified in the [4-18] setting.

The setting values are as follows: "1 pF", "2pF", "4pF".

If you don't know the maximum capacitance, you should specify the 4.00pF as a setting value of the [4-18].

- Corresponding register: the Static OffCal CDAC Base Register (Address=0x39).

[4-19] Dynamic Offset Calibration [Plus Data Time]

The [4-19] setting can specify the dynamic offset calibration time for the positive range of measurement data. Automatically, using the [4-19] setting value and so on, the application software calculates and determines the setting value as appropriate as possible for the Dynamic OffCal Time Plus Register (Address=0x37). If the number of consecutive judgment points that measurement data is consecutively within the positive range(4 to threshold) for dynamic offset calibration at the consecutive judgment timings becomes equal to the value of the "dynamic-offset -calibration-execution counts" which is specified by the Dynamic OffCal Time Plus Register (Address=0x37), dynamic offset calibration is automatically performed. Note that the value of the "dynamic-offset- calibration-execution counts" equals 8 times the value which is specified by the Dynamic OffCal Time Plus Register (Address=0x37).

The "Max : xxxms", which is shown below the [4-19] setting, is the maximum value of the dynamic offset calibration time for the positive range of measurement data, which is calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" as a setting value of the [4-19].

- Corresponding register: the Dynamic OffCal Time Plus Register (Address=0x37)

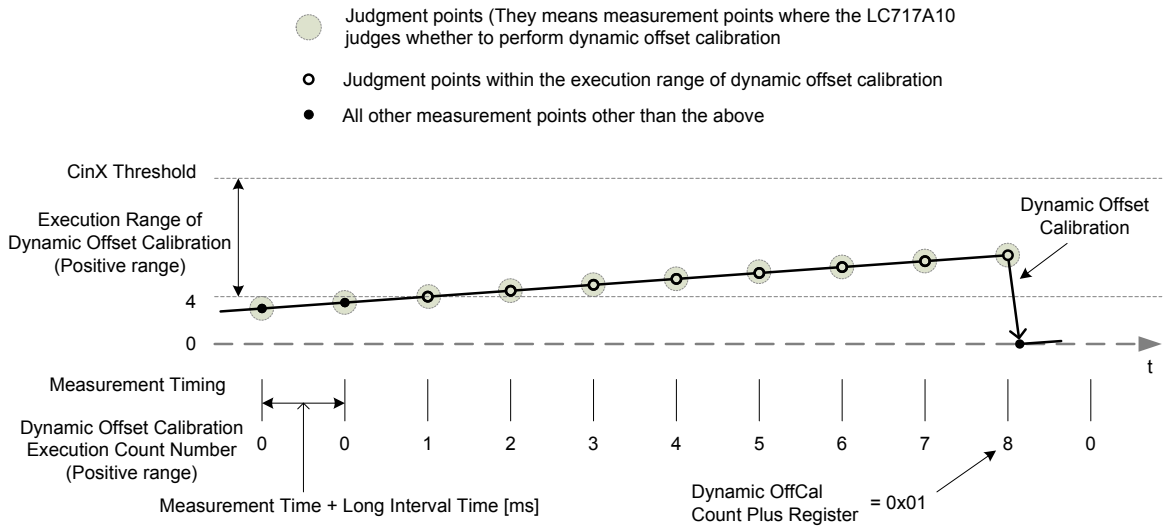

Fig 2.28 Dynamic offset calibration for the positive range during long interval mode (In the case that the setting value of the Dynamic Offcal Count Plus Register is 0x01. About the detail, please refer to the Application Note (another document).)

[4-20] Dynamic Offset Calibration [Minus Data Time]

The [4-20] setting can specify the dynamic offset calibration time for the negative range of measurement data. Automatically, using the [4-20] setting value and so on, the application software calculates and determines the setting value as appropriate as possible for the Dynamic OffCal Time Minus Register (Address=0x38). If the number of consecutive judgment points that measurement data is consecutively within the negative range(-128 to -4) for dynamic offset calibration at the consecutive judgment timings becomes equal to the value of the "dynamic-offset -calibration-execution counts" which is determined by the Dynamic OffCal Time Minus Register (Address=0x38), dynamic offset calibration is automatically performed. Unlike the [4-19] Dynamic Offset Calibration [Plus Data Time] described above, note that the value of the "dynamic-offset- calibration-execution counts" equals the value which is specified by the Dynamic OffCal Time Minus Register (Address=0x38]).

The "Max : xxxms", which is shown below the [4-20] setting, is the maximum value of the dynamic offset calibration time for the negative range of measurement data, which is calculated according to the current configurations. Please enter a value less than the value of the "Max : xxxms" as a setting value of the [4-20].

- Corresponding register: the Dynamic OffCal Time Minus Register (Address=0x38)

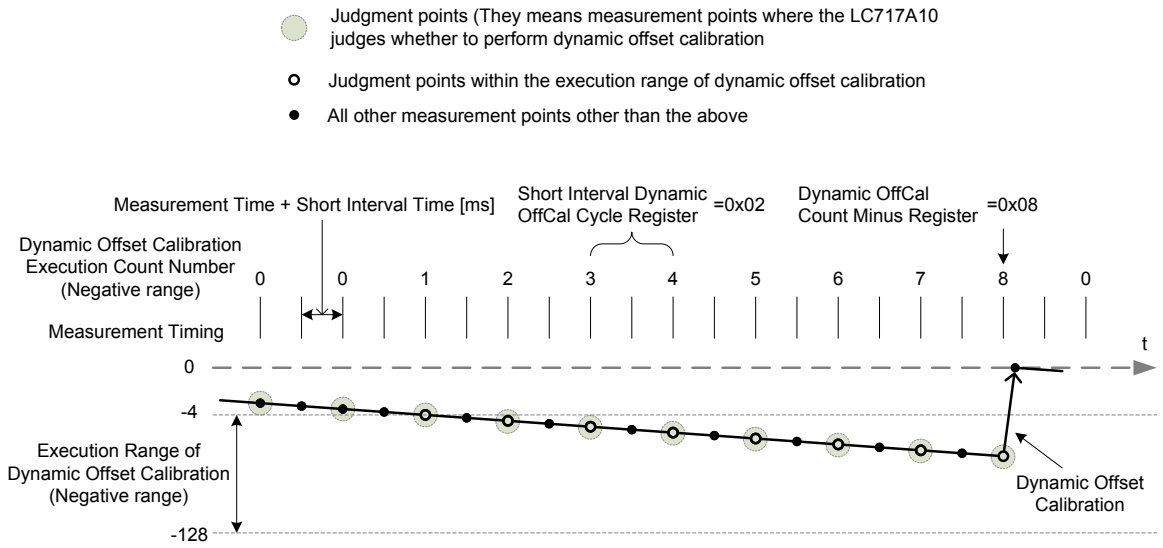

Fig 2.29 Dynamic offset calibration for the negative range during short interval mode (In the case that the setting value of the Short Interval Dynamic Offcal Cycle Register is 0x02 and the setting value of the Dynamic Offcal Count Minus Register is 0x08. About the detail, please refer to the Application Note (another document).)

[4-21][INTOUT Assert Condition]

The [4-21] setting is used to select the condition for asserting the INTOUT.

When you select "Measurement", the INTOUT is asserted at the timing that the measurement of all the enabled channels has completed in the LC717A10.

On the other hand, when you select "Touch ON", the INTOUT is asserted only at the timing that the measurement of all the enabled channels has completed in the LC717A10 and touching ON are detected at one or more channels of the LC717A10.

- Corresponding register: the INTMD1 bit in the Measurement Mode 1 Register (Address=0x3A).

[4-22][INTOUT Negate Condition]

The [4-22] setting is used to select the condition for negating the INTOUT.

When "Manual" is selected, the INTOUT isn't negated automatically.

When "Automatic" is selected, the INTOUT is always negated automatically either at the end of interval processing (in the case of interval mode) or at the wake-up of the LC717A10 (in the case of sleep mode).

When the INTOUT is asserted, INTOUT output level is "High". On the other hand, when it is negated, the INTOUT output level is "Low".

 Corresponding register: the INTMD2 bit in the Measurement Mode 1 Register (Address=0x3A).

[4-23][Touch ON Dynamic OffCal(Plus Data)]

The [4-23] setting is used to select the dynamic offset calibration method for the positive range of measurement data.

In the case that "Disable" is selected: When one or more channels are in "Touch ON" state, the LC717A10 doesn't perform the dynamic offset calibration for the positive range of measurement data at all the enabled channels.

In the case that "Enable" is selected: When one or more channels are in "Touch ON" state, the LC717A10 performs the dynamic offset calibration for the positive range of measurement data at all the enabled channels other than the "Touch-ON-state" channels.

 Corresponding register: the PDCLP bit in Measurement Mode 1 Register (Address=0x3A).

[4-24][Cin8-Cin15 Cref]

The [4-24] setting is used to select the port connected as a differential pair when Cin8 to Cin15 are measured.

When "Cref" is selected, the port used as a differential pair is Cref when Cin8 to Cin15 are measured.

When "Cref+CrefAdd" is selected, the ports used as a differential pair are both Cref and CrefAdd (combinations of two capacitors) when Cin8 to Cin15 are measured.

 Corresponding register: the CIN8CINP2 bit in the Measurement Mode 2 Register (Address=0x3B).

[4-25][Cin0-Cin7 Cref]

The [4-25] setting is used to select the port connected as a differential pair when Cin0 to Cin7 are measured.

When "Cref" is selected, the port used as a differential pair is Cref when Cin0 to Cin7 are measured.

When "Cref+CrefAdd" is selected, the ports used as a differential pair are both Cref and CrefAdd (combinations of two capacitors) when Cin0 to Cin7 are measured.

 Corresponding register: the CIN0CINP2 bit in the Measurement Mode 2 Register (Address=0x3B).

[4-26][Debounce Count for (OFF->ON)]

The [4-26] setting can specify the de-bounce count which is used for decision of Touch "OFF". In other words, the LC717A10 uses the [4-26] setting when the touch status of each enabled channel changes from ON state to OFF state.

- Corresponding register: the Debounce Count 1 Register (Address=0x32).

[4-27][Debounce Count for (ON->OFF)]

The [4-27] setting can specify the de-bounce count which is used for decision of Touch "ON". In other words, the LC717A10 uses the [4-27] setting when the touch status of each enabled channel changes from OFF state to ON state.

- Corresponding register: the Debounce Count 2 Register (Address=0x33).

[4-28][Gain(1st)]

Each of the [4-28] settings can specify the 1st-amplifier gain setting of each channel. The gain setting of the 1st-amplifier from Cin0 to Cin7 is set in common. The gain setting of the 1st-amplifier from Cin8 to Cin15 is set in common. It can't be set individually for each channel (In other words, Cin). The unit is femtofarads.

The setting values are as follows: "1600","1500","1400","1300","1200","1100","1000","900","800","700", "600","500","400","300","200", "100".

Normally, specify the gain of the 1st-amplifier at the minimum.

- Corresponding register: the Cin 1st Gain Adjust Register (Address=0x3D)

[4-29][Average Count]

The [4-29] setting can specify the average counts when the LC717A10 measures data at a certain channel. (Do not set a number but 8, 16, 32, 64 and 128.)

The setting values are as follows: "8 times","16 times","32 times","64 times","128 times".

- Corresponding register: the Average Count Register (Address=0x30)

[4-30][Filter Parameter 1]

The [4-30] setting can specify the value of the filter parameter 1.

When you specify "0" as the filter parameter 1, the LC717A10 doesn't the internal processing of noise suppression.

- Corresponding register: the FP10 to the FP13 bit in the Filter Parameter Register (Address=0x31)

[4-31][Filter Parameter 2]

The [4-31] setting can specify the value of the filter parameter 2.

- Corresponding register: the FP20 to the FP23 bit in the Filter Parameter Register (Address=0x31)

[4-32][Touch OFF Thr.]

The [4-32] setting is used to select the threshold which is applied when the state of each enabled channel changes from "ON" state to "OFF" state from either "=3/4*Peak" or "=1/2*Peak".

When you select "=3/4*Peak", the threshold which is applied when the state of each enabled channel changes from "ON" state to "OFF" state is 3/4 of the peak value of measurement data while detecting the "Touch ON". However, when the 3/4 of the peak value is less than the value specified in the [4-9][Touch Thr.], the value specified in the [4-9][Touch Thr.] is applied as the value of the threshold which is applied when the state of each enabled channel changes from "ON" state to "OFF state".

On the other hand, when you select "=1/2*Peak", the threshold which is applied when the state of each enabled channel changes from "ON" state to "OFF" state is 1/2 of the peak value of measurement data while detecting the "Touch ON". However, when the 1/2 of the peak value is less than the value specified in the [4-9][Touch Thr.], the value specified in the [4-9][Touch Thr.] is applied as the value of the threshold which is applied when the state of each enabled channel changes from "ON" state to "OFF" state.

- Corresponding register: the TOFFTH bit in the Measurement 1 Mode Register (Address=0x3A)

2.5. Sub test window

Using "Sub test window" enables access to any register of the LC717A10. The window is used to read/write the registers of the LC717A10 for testing purpose.

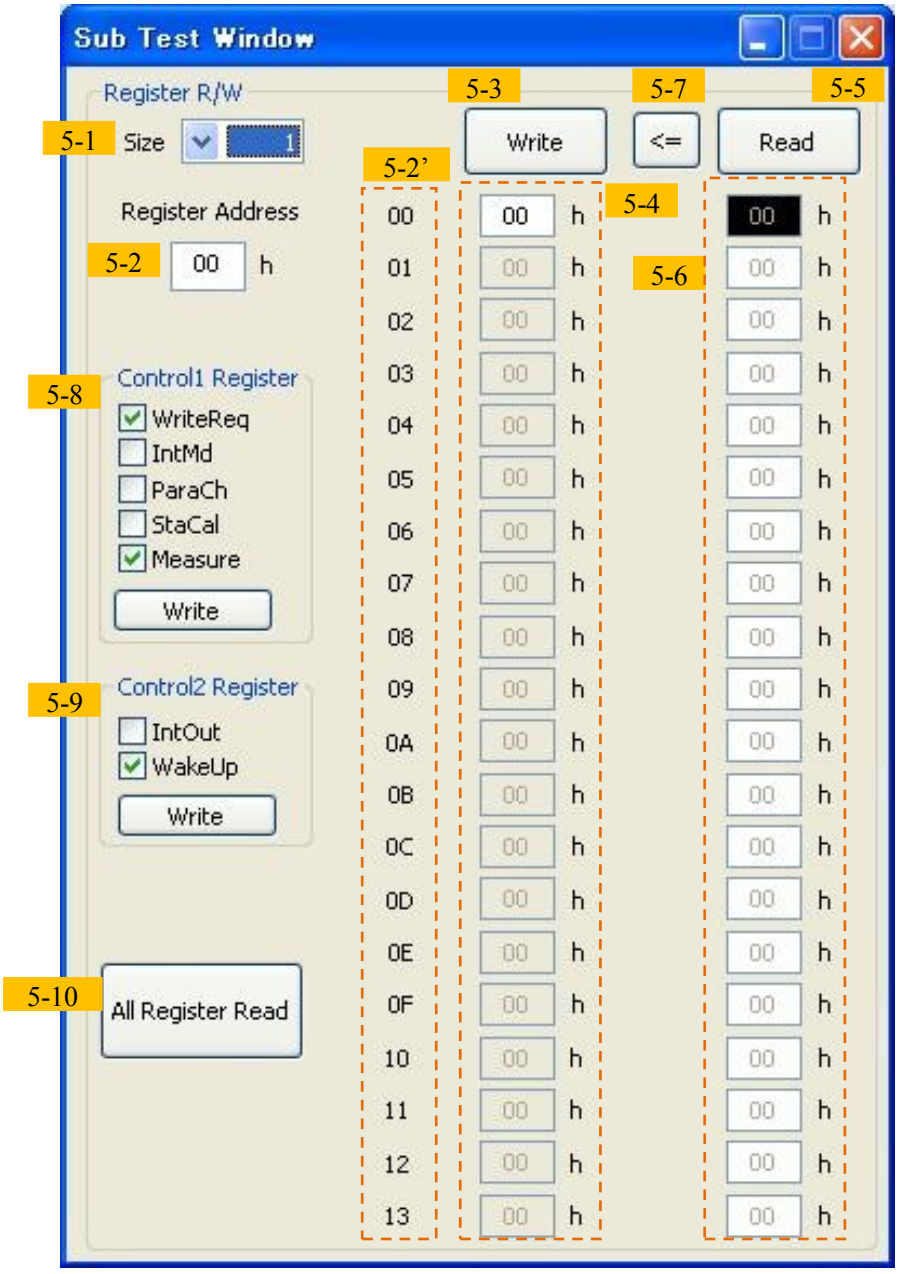

Fig 2.30 Sub test window

[5-1][Size] checkbox

The [5-1] setting can specify either the data size for reading from the registers or the data size for writing to the registers (unit: byte).

[5-2] / [5-2']][Register Address]

The [5-2] setting can specify the starting register address for reading from the registers or the starting register address for writing to the registers.

When you set the address value, the address values to read/write data (shown on the [5-2'] area) are also updated.

[5-3][Write] button

When you click on the [5-3] button, the application software writes data (which are specified in the [5-4] [Write data]) into the specified registers of the LC717A10.

[5-4][Write data]

The [5-4] setting can specify write data which is written into the LC717A10 when the [5-3][Write] button is clicked.

[5-5][Read] button

When you click on the [5-5] button, the application software reads data from the specified registers of the LC717A10.

[5-6][Read data]

The application software shows data which are read by clicking on the [5-5][Read] button.

[5-7][<=] button

When you click on the [5-7] button, the application software copies the contents of the [5-6][Read data] to the [5-4][Write data].

[5-8][Control 1 Register]

If you click on the "Write" button on the [5-8][Control 1 Register] area, the application software writes the value which depends on which checkboxes are checked to only the Control 1 Register (Address=0x2F).

For example, if you check all the checkboxes of the "WriteReq" checkbox, the "IntMd" checkbox, the "ParaCh" checkbox, the "StaCal" checkbox and the Measure checkbox, the application software writes the value of "0x89" to the Control 1 Register (Address=0x2F).

[5-9][Control 2 Register]

If you click on the "Write" button on the [5-9][Control 2 Register] area, the application software writes the value which depends on which checkboxes are checked to only the Control 2 Register (Address=0x40).

For example, if you check only the "IntOut" checkboxes, the application software writes the value of "0x02" to the Control 2 Register (Address=0x40).

[5-10][All Register Read] button

When you click on the [5-10] button, the application software reads all the register values of the LC717A10, and then it saves them to the file "LC717A10_RegData.txt" in the same folder as the application software executable file "LC717A10App.exe.

2.6. Initial configuration at the startup of the application software

The file "SetParamDefault.prm", which is in the same folder where the application software executable file is present, contains various initial setting values for the application software.

In particular, if both the "SetParamDefault.prm" and the application software executable file are in the same folder, the file "SetParamDefault.prm is loaded automatically at the startup of the application software, and then the application software performs initial configuration according to the contents of the file.

On the other hand, if the "SetParamDefault.prm" and the application software executable file are not in the same folder, a file dialog box opens automatically at the startup of the application software.

If you select another setting file on the file dialog box, the application software loads it and performs initial configuration according to the contents of the setting file.

If you close the dialog box without selecting any setting file on the dialog box, the application software only performs initial configuration which is minimum required. After the application has completed the start-up, you have to set all the settings of the application software. (It's troublesome.)

2.7. How to enable the application software to play wav files when you touch each switch

When a switch changes from OFF state to ON state, the application software can play a specified wav files corresponding to the number of the switch.

How to enable the application software to play wav files when you touch each switch is as follows:

- Prepare wav files.
- Rename the filename of each wav file to "TouchSWx.wav" (x=1,2,3,...16). (Actually, the maximum number of wav files, x, is 64(=8x8).)
- Create a folder named "wave" in the folder that contains the application software executable.
- Place the wav files in the "wave" folder.

By doing the above, when the state of a switch changes from OFF state to ON state, the application software plays the wav file corresponding to the number of the switch. For example, the application software plays ".\wave\TouchSW3.wav" when the switch SW3 changes from OFF state to ON state, and it plays ".\wave\TouchSW7.wav" when the switch SW7 changes from OFF state to ON state.

*: I^2C Bus is a Trademark of Philips