IS31SE5118/IS32SE5118 EvB User's Manual

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1. HARDWARE ENVIRONMENT

1.1 Appearance of Evaluation Board (EvB)

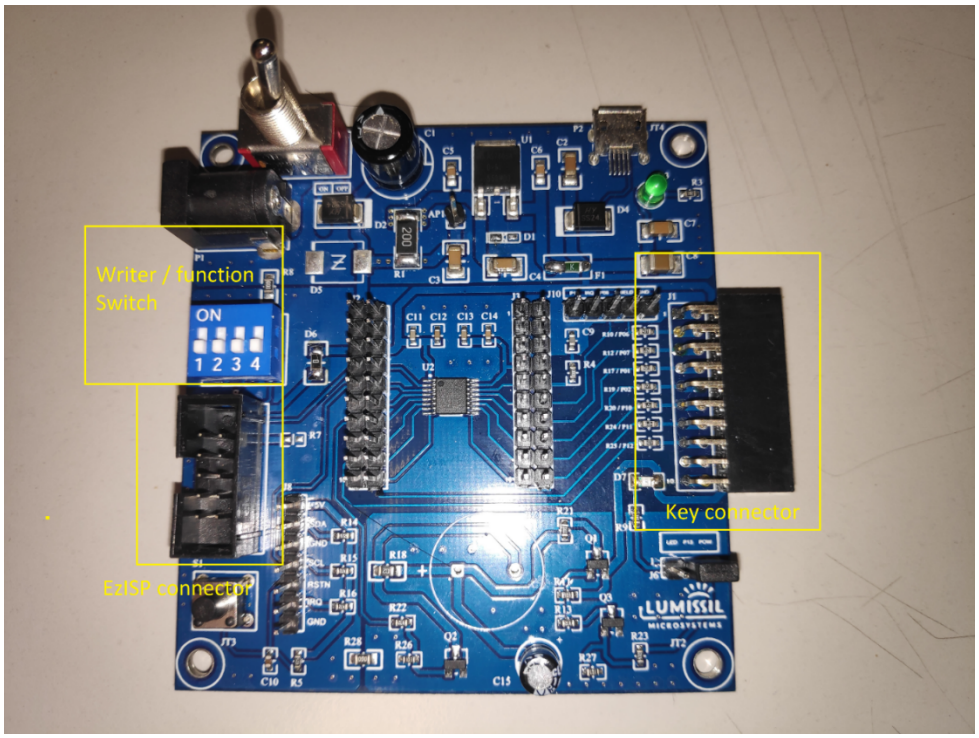

Figure 1: Photo of IS31SE5118 Evaluation Board

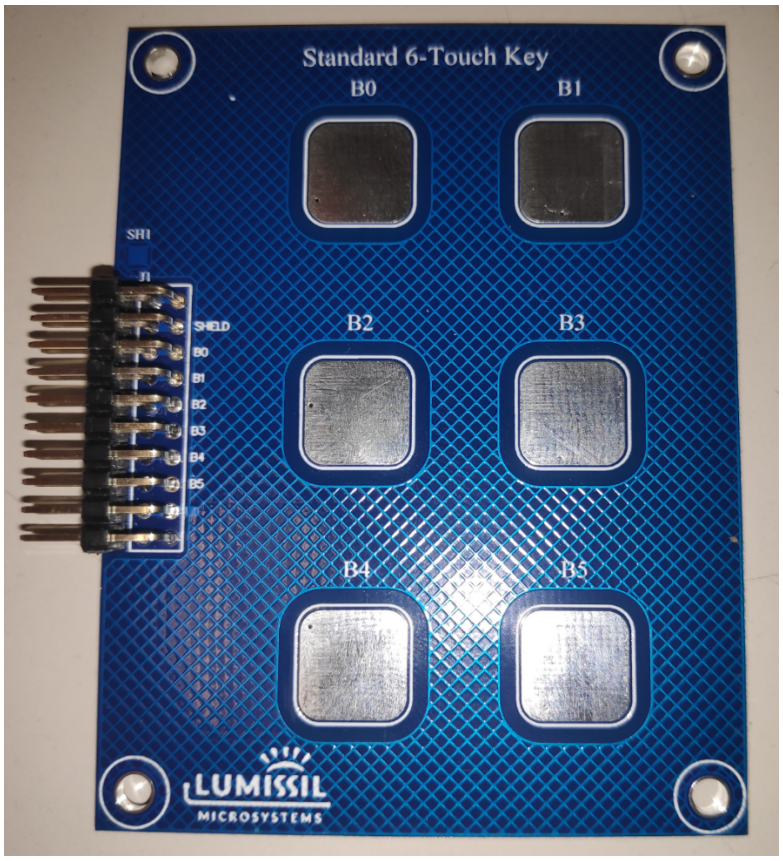

Figure 2: Photo of touch key PCB

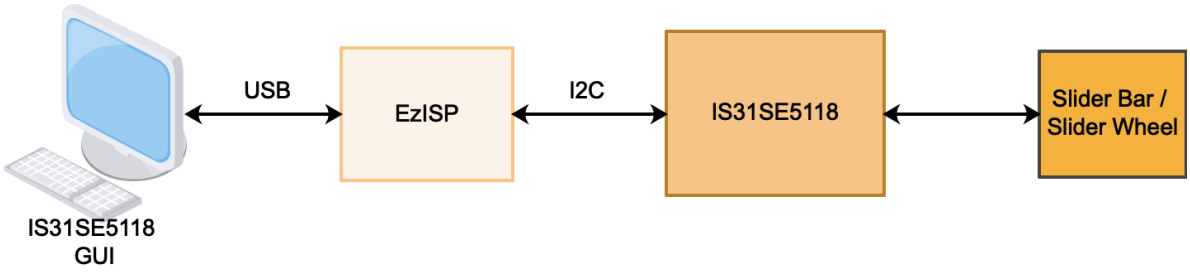

Figure 3: IS31SE5118 Evaluation Board connection block diagram

1.2 Schematic of Evaluation Board

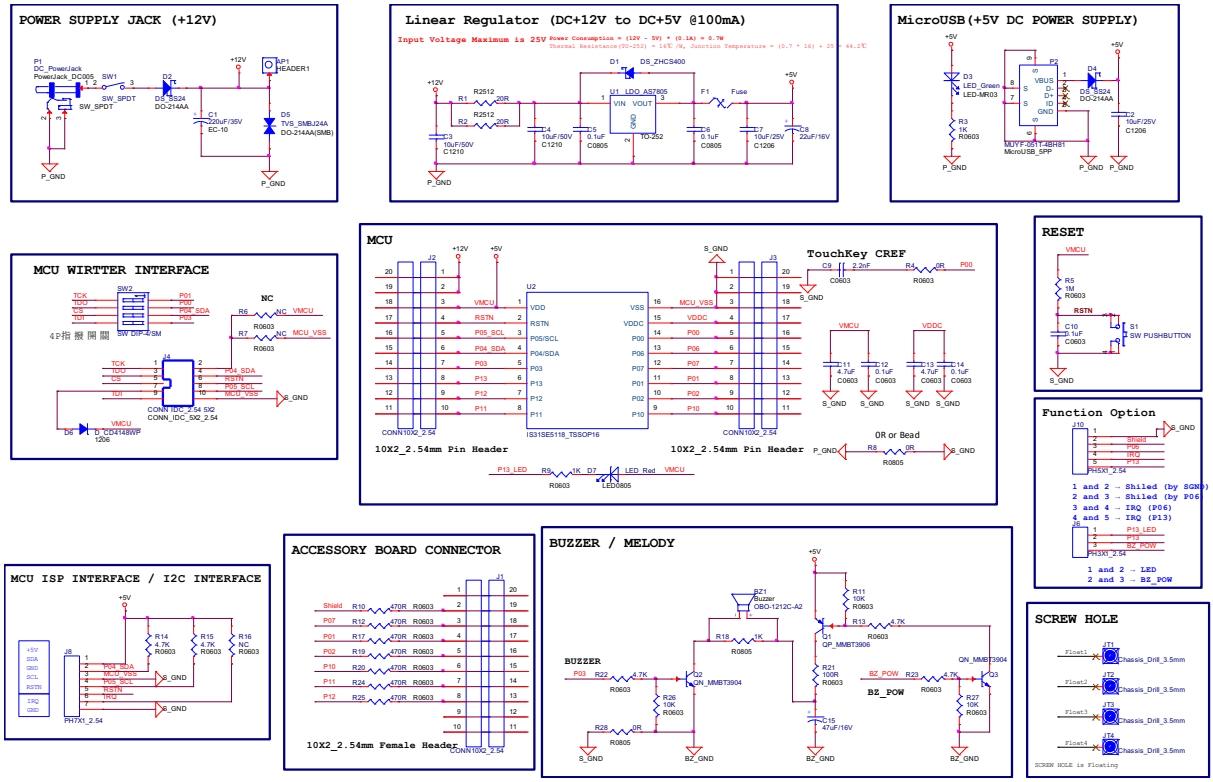

Figure 4: Schematic of IS31SE5118 Evaluation Board

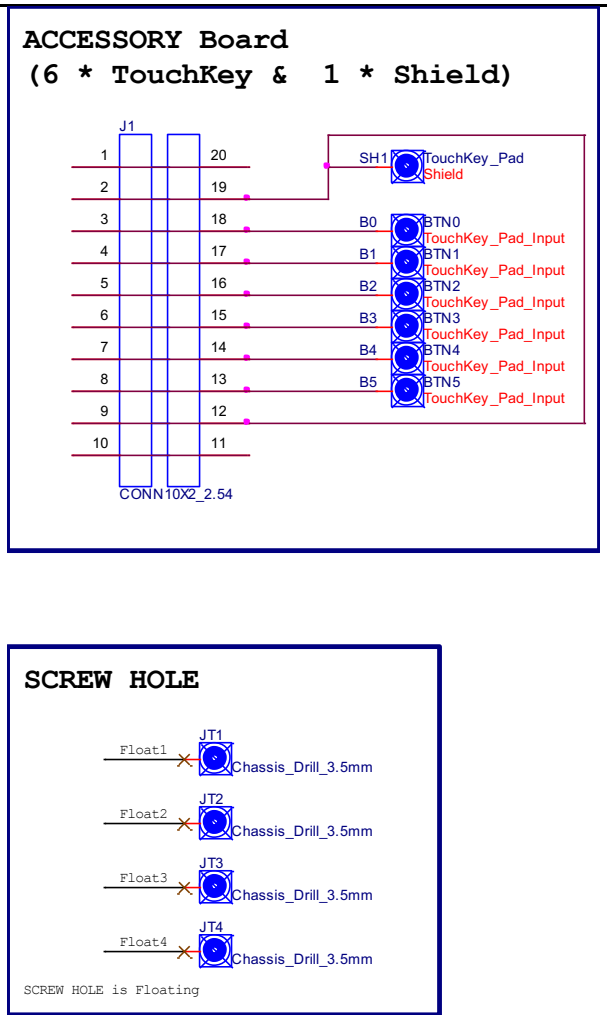

Figure 5: Schematic of Key PCB

1.3 ORDERING INFORMATION

Part No.	Temperature Range	Package
IS31SE5118-ZNLS3-EBGUI	-40°C ~ +105°C	TSSOP-16, Lead-free

Table 1: Ordering Information

For pricing, delivery, and ordering information, please contact LUMISSIL's marketing and sales team at http://www.lumissil.com/company/office-locations or (408) 969-6600.

2. SOFTWARE SUPPORT

2.1 Software Requirements

Before using the GUI, the PC first needs to install the EzISP USB driver and related files (for example: Microsoft Framework and C++ library).

Figure 6: Photo of EzISP Board

Note: If there is no ".NET Framework" or the version lower than revision 4.0 on Windows system, ".NET Framework" should be downloaded as below link and install it.

https://www.microsoft.com/en-us/download/confirmation.aspx?id=24872

2.2 Run GUI Program

GUI operation process is as follows:

I2C Slave Address*	Write Command	Read Command
	0x78	0x79

Table 2: I2C slave address definition

* I2C Slave Address: 7-bit Address + 1 bit(R/W)

(1) Connect USB cable between the connector of the EzISP Board and the USB port of your PC.

(2) Use a 10-pin 2x5 Socket-Socket 2.54mm IDC cable from the connector on the EzISP Board to the connector on the IS31SE5118 Evaluation Board.

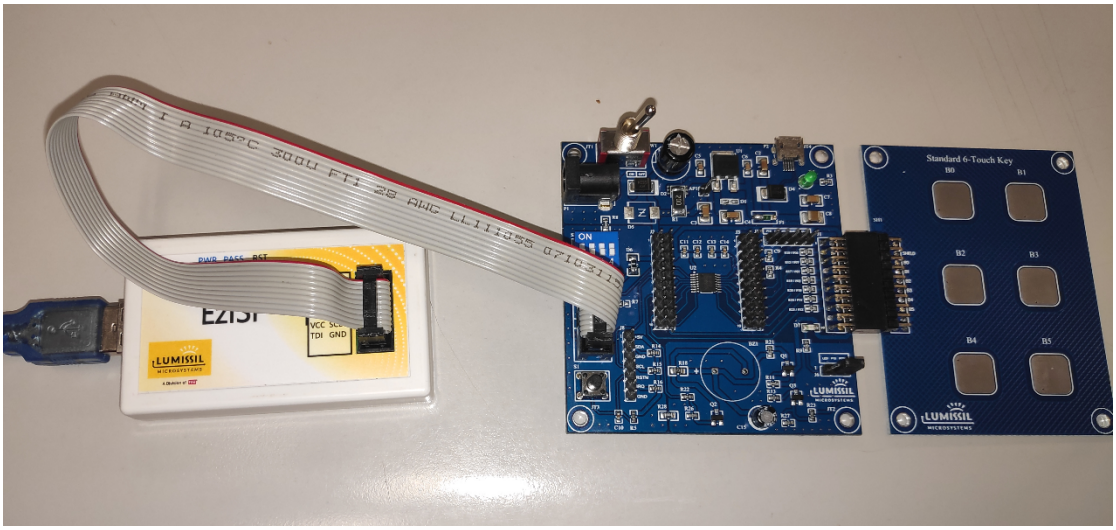

Figure 7: Connection of IS31SE5118 evaluation board and EzISP board

(1) Execute GUI program (file name: TouchKeyGUI_5118_rls.exe).

3. GUI INTERFACE

3.1 Connect Status

As shown in **Error! Reference source not found.** & **Error! Reference source not found.** below, It's no need to select the I2C AD value. The Connect Status will be displayed as "Connect" (with a green box), and the following settings can be selected by click button Connect. Otherwise, the Connect Status will be displayed as "Disconnect" (with a red box) and cannot select any of the following settings.

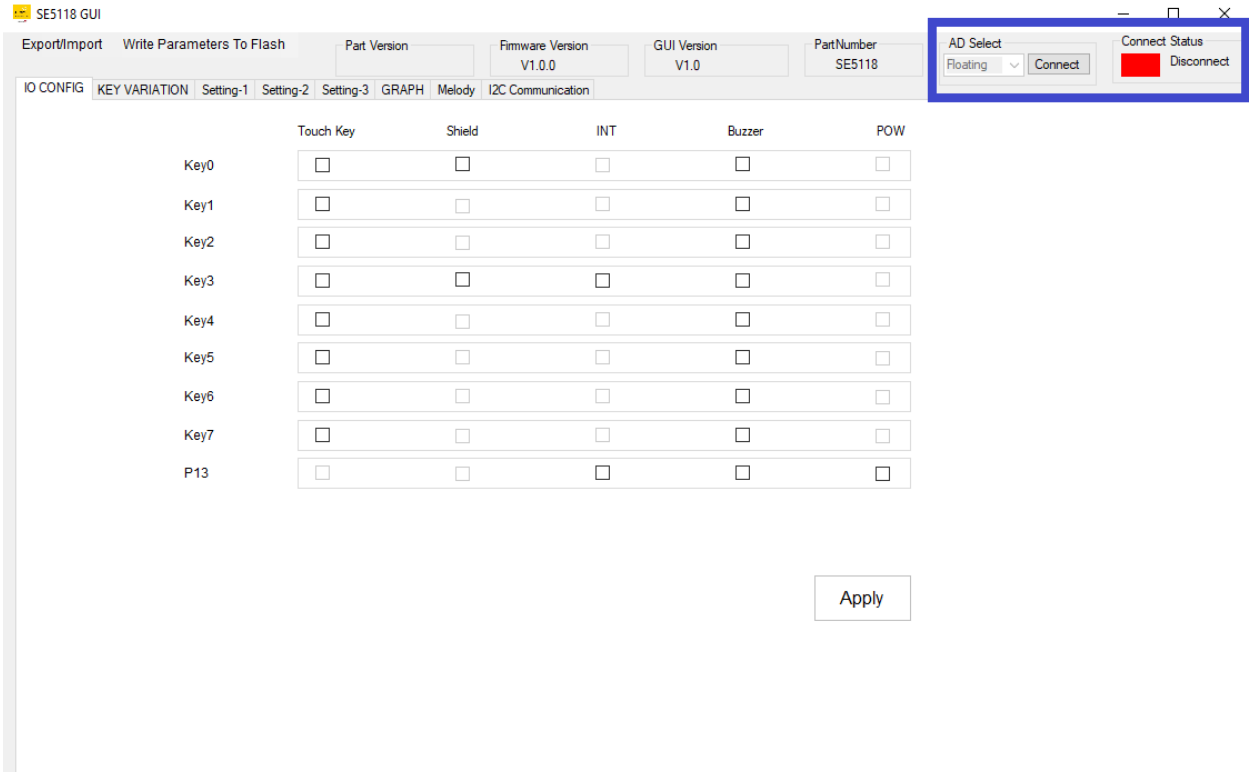

Figure 8: GUI connect status shows disconnect

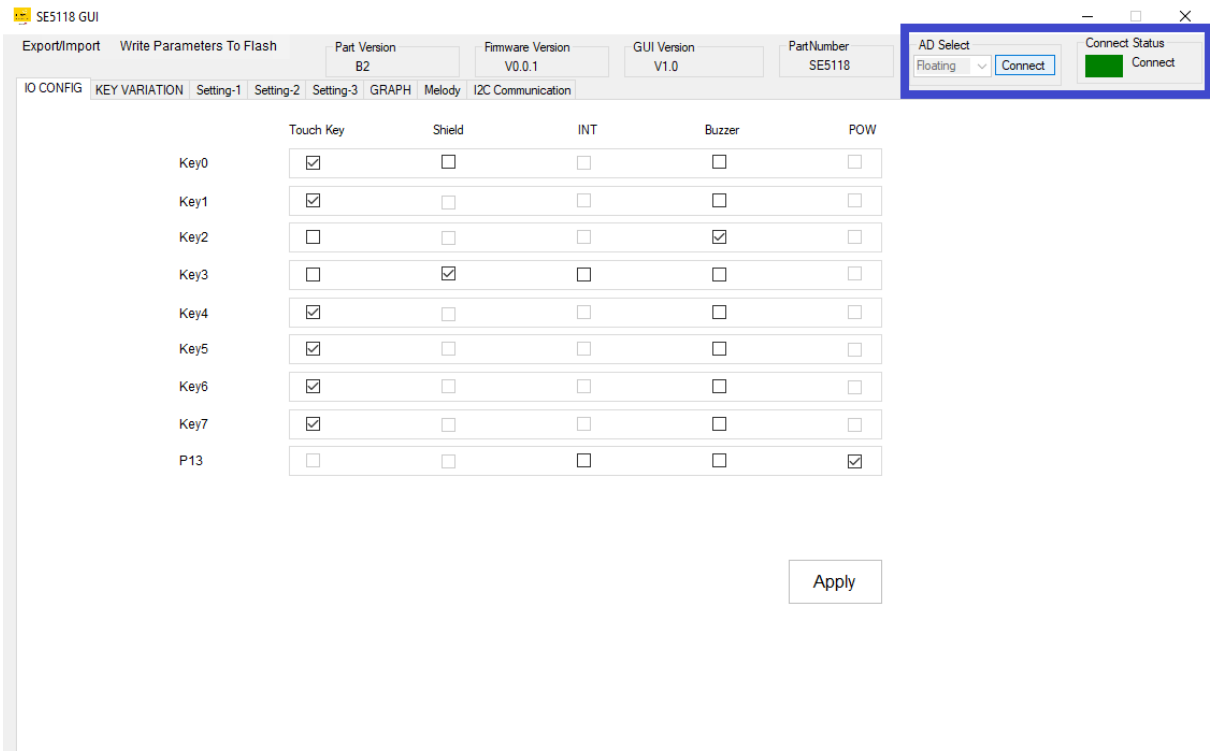

Figure 9: GUI connect status shows connect

3.2 Export/Import

As shown in **Error! Reference source not found.** below, "Export Register List" is used to export the register list of IS31SE5118. By exporting the register list, we can save the parameters set by the GUI to the computer. "Import Register List" is used to import the register list of IS31SE5118. By importing the register list, we can load the parameter file of the previous GUI settings into the computer.

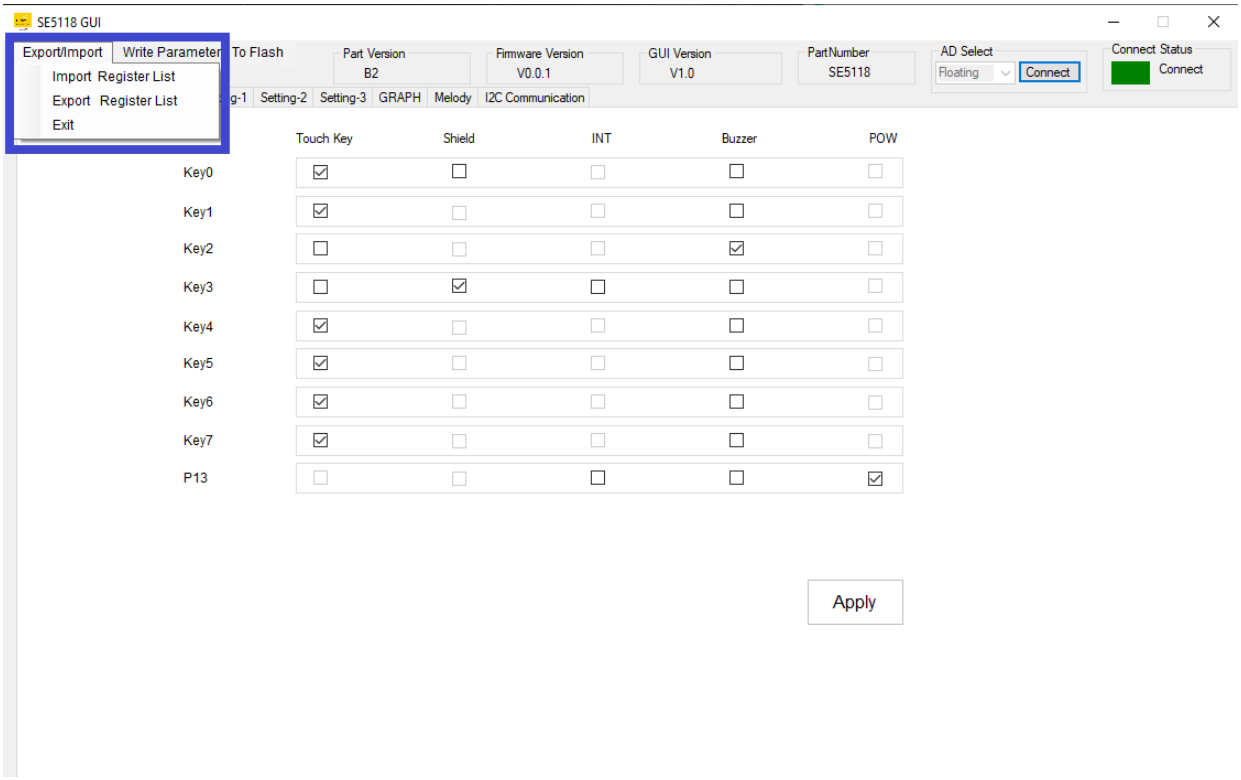

Figure 10: GUI export/import options

3.3 Write Parameters to Flash

As shown in **Error! Reference source not found.** below, the user can write the parameters set by the GUI into the flash memory of the IS31SE5118 chip. After clicking the "Write Parameters to Flash Memory" on the Menu Bar, the operation of writing parameters to Flash memory can be completed in about 4 seconds.

The embedded Flash Memory has the capability to hold saved data even if the power is turned off. When the chip is turned on again, the parameters previously written to the flash memory will become the default values.

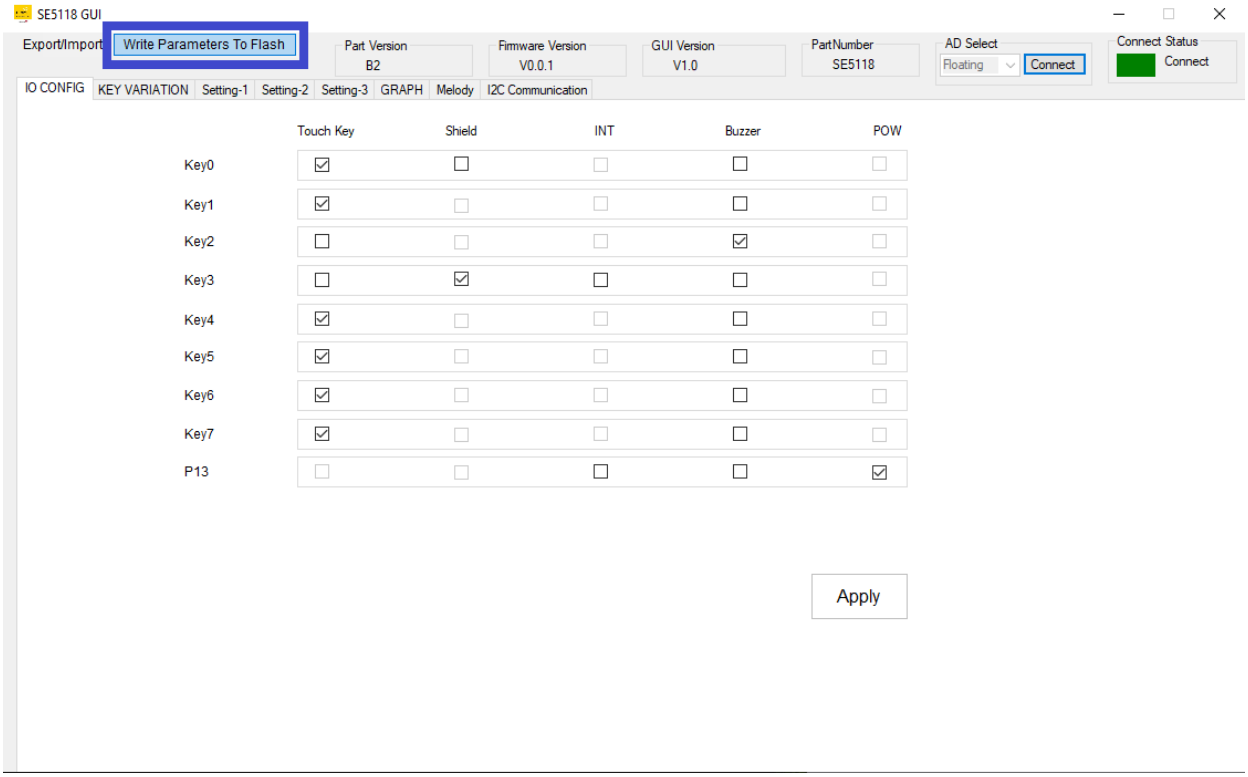

Figure 11: GUI write parameters to Flash options

4. IO CONFIG

4.1 IO Config Setting

As shown in **Error! Reference source not found.** below, after click "Connect" button and the Connect Status shows "Connect", it means the EvB has been successfully connected. As shown in the green box in **Error! Reference source not found.**12, the GUI will identify and display the correct firmware version, software version and chip part number.

Users should click "Apply" button located at bottom right corner to submit setting.

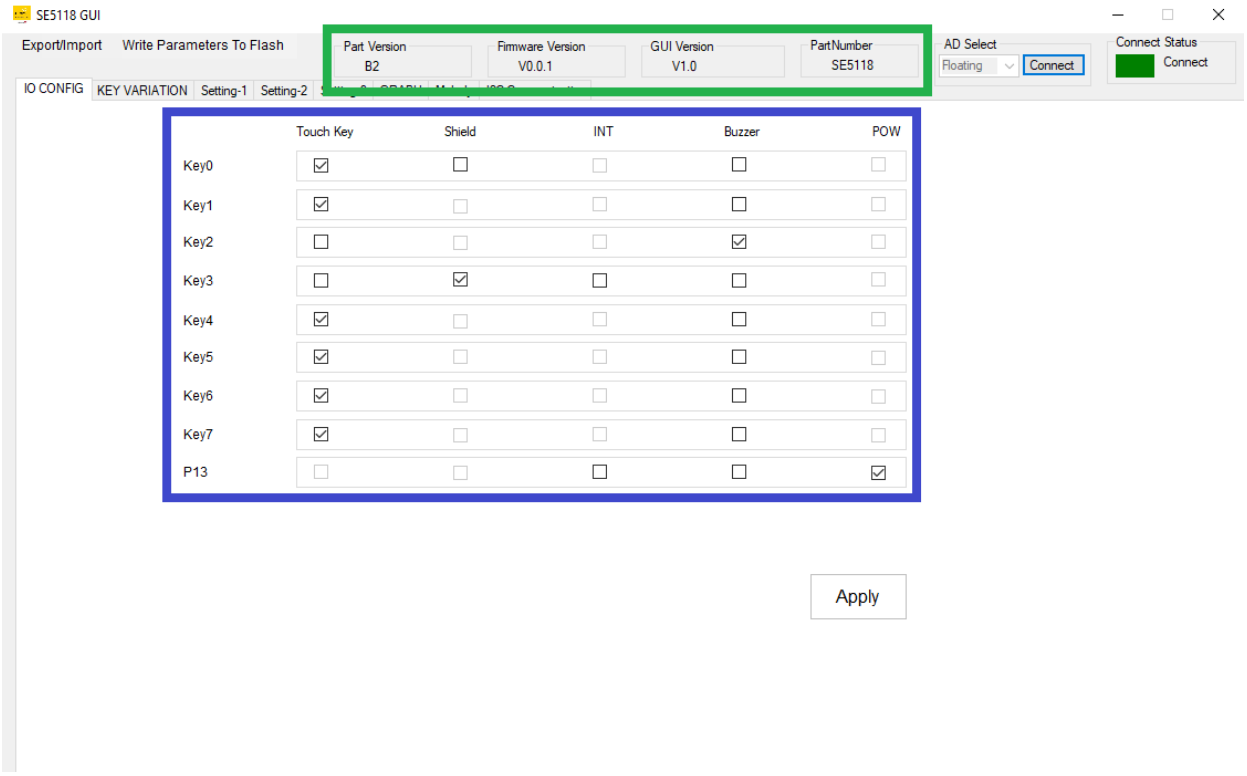

Figure 12: GUI preset IO configuration

5. KEY VARIATION

5.1 Operating Mode Switching

As shown by the red box in **Error! Reference source not found.**, IS31SE5118 EvB is in normal mode, and the corresponding indicator light will turn green. After pressing the "Sleep" button, IS31SE5118 EvB will enter sleep mode, and the corresponding indicator light will turn red. At this time, IS31SE5118 can only be woken up by the key that has been previously set as a touch key and the wake-up function is enabled to return to Normal Mode.

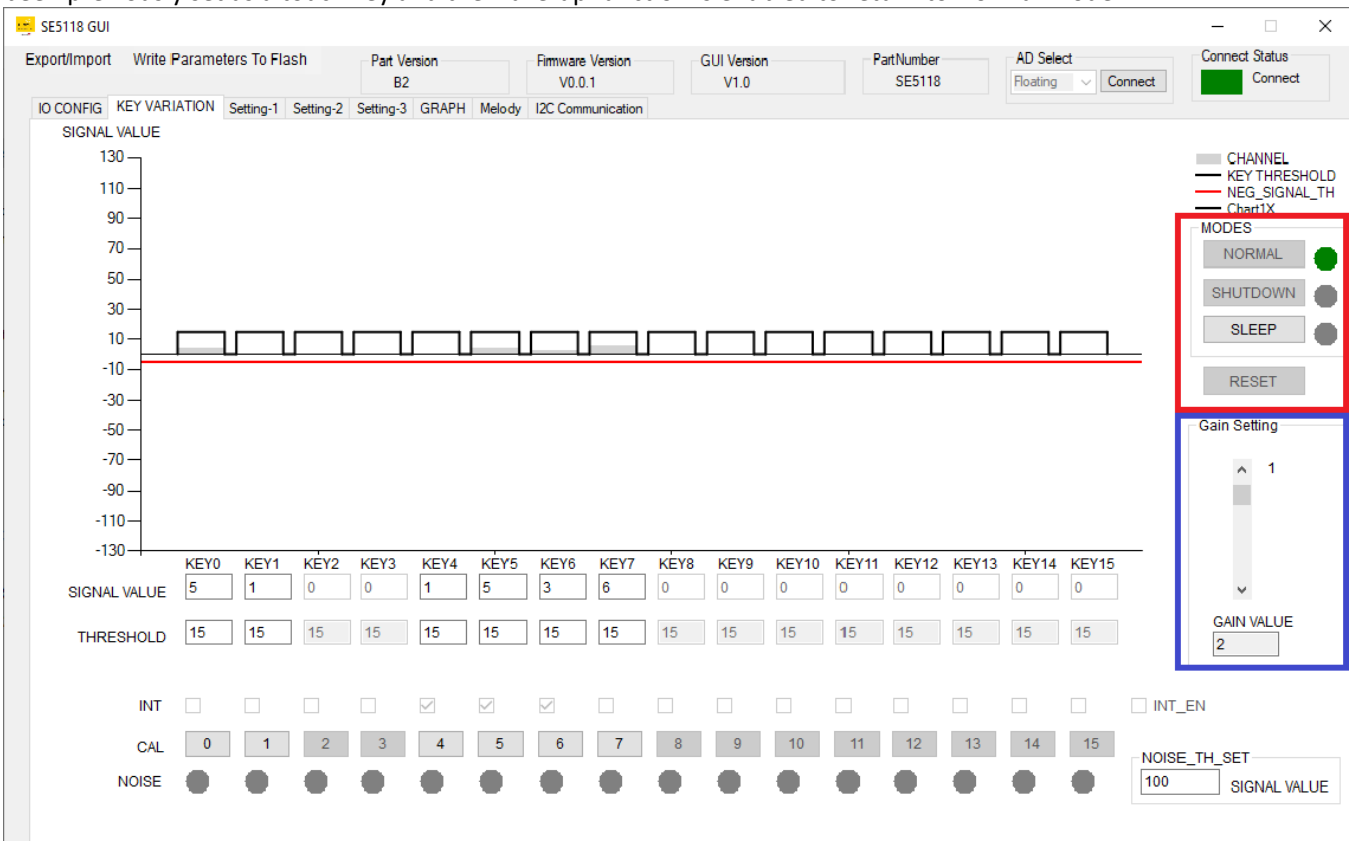

Figure 13: Key Variation page of GUI

Note: If the user sets a specific key to GPIO (high) or GPIO (low), when IS31SE5118 EvB enters sleep mode, this key will continue to maintain its previous state.

5.2 Gain Setting

The button Gain_Setting in the blue box in **Error! Reference source not found.** above is used to set gain for the touch keys. The gain could be set in 1~16 levels by pulling the scroll bar and the current gain value will be shown in bottom.

Setting gain will affect the sensitivity of all the touch keys. If gain value is set too large, high sensitivity of keys may cause a false trigger. Therefore, the touch key gain setting should be adjusted according to the actual touch button size and working environment.

5.3 Threshold of Key

As shown in Figure 14 below,

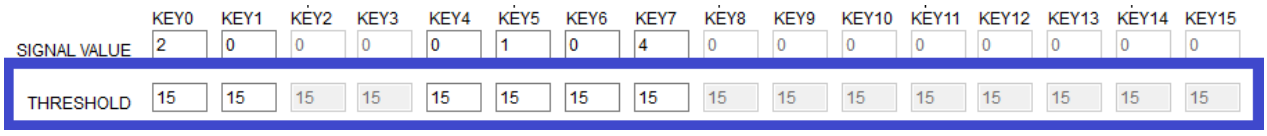

Figure 14: Threshold setting

THRESHOLD is used to set the threshold of keys (KEY0-KEY7). The maximum value is 127. GUI will keep 127 if input value is over 127. Input data in the corresponding box and press Enter or Tab key, or move the cursor to another location will set up the threshold.

Put mouse on corresponding box, for example in KEY0, will show a table in the red box as shown in **Error! Reference source not found.**5. The whole interface has prompted box for each programmable parameter.

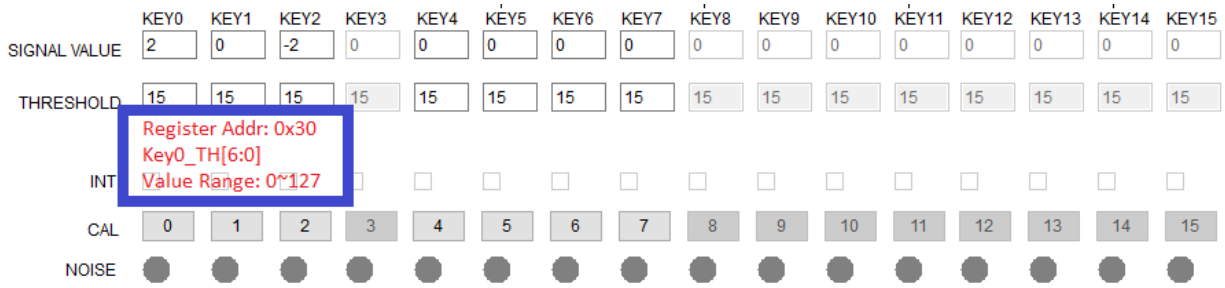

Figure 15: Set the threshold of KEY0

The address of KEY0 THRESHOLD Register is 0x30.

KEY0_TH[6:0] are the setting bits of KEY0 THRESHOLD Register (0x30).

Threshold range is from 0 to 127.

Key will be triggered when the environmental capacitance of touch key is over key threshold.

5.4 Value of KEY

As shown in **Error! Reference source not found.** below,

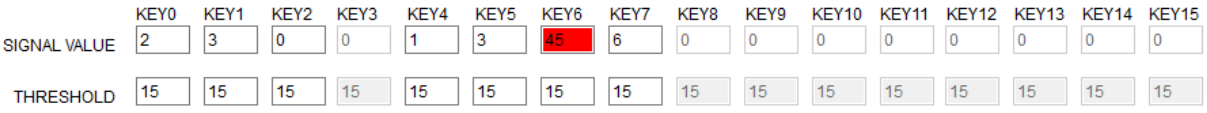

Figure 16: The VALUE of the KEY

VALUE is the current touch key value. It shows environmental capacitance if there is no object close to touch key. The corresponding value will be display in the box when pressing KEYs (KEY0~KEY7) on EvB. The box turns red if value is over key threshold and it means this key is triggered.

5.5 Key and interrupt enable

As shown in Figure 17 below is an example. If you want to disable KEY0, you cannot select the check box in the KEY0 column of the IO CONFIG page. Key enable setting could shut down any touch key. If disable the KEY0 and KEY1~KEY7 is enabled, there is no changing by touching KEY0.

Note: If KEY is set to GPIO (High) or GPIO (low) on the IO CONFIG page, the key enable setting corresponding to KEY will also be disabled.

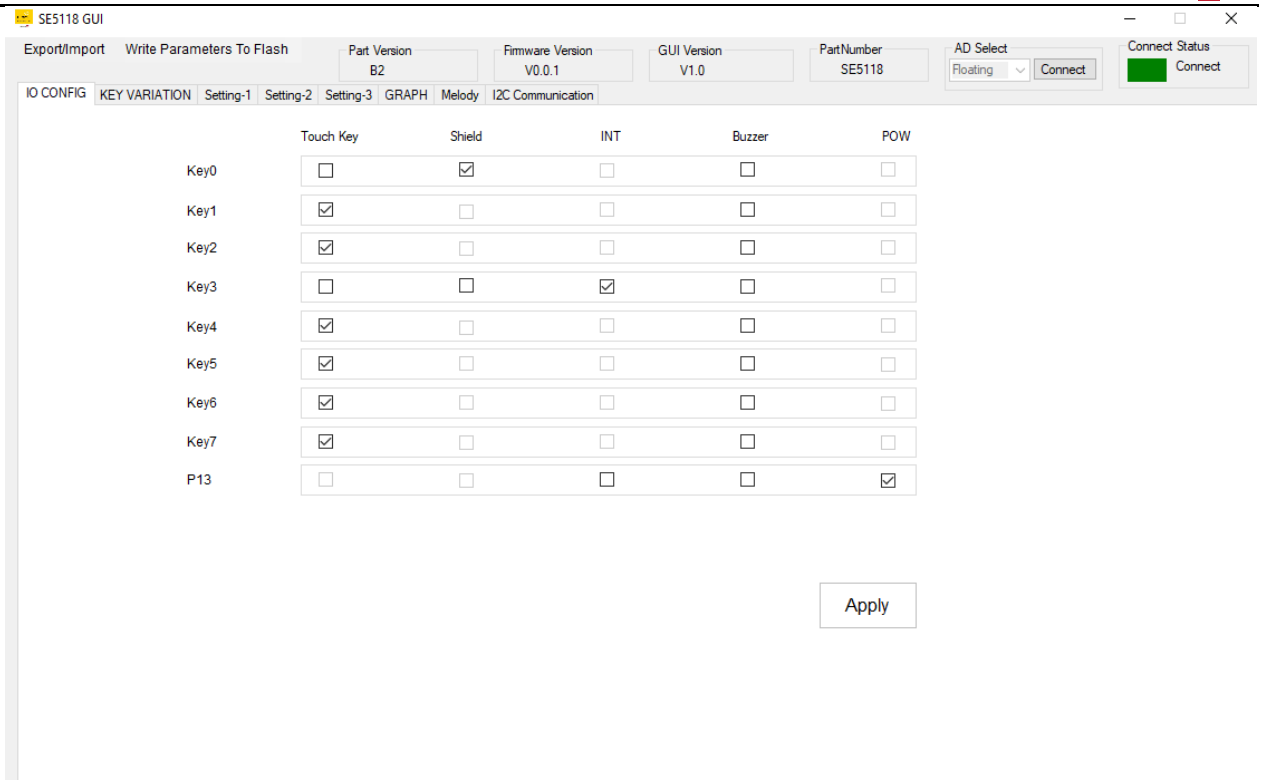

Figure 17: Set EN of KEY0 to disable

Interrupt enabled setting, as shown in Figure 18 below,

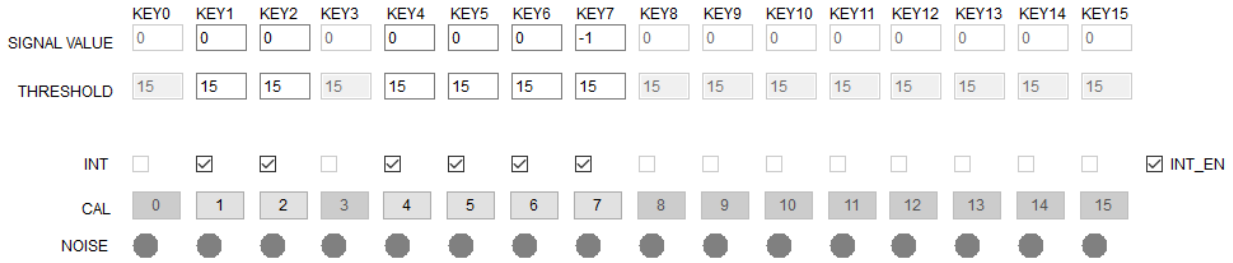

Figure 18: KEY's INT and INT_EN

Checking in the box is the action of enable interrupt function, no checking means disable. INT_EN should be set to enable first when configure key interrupt for KEY0~KEY7. INT_EN is the global interrupt setting. If it is disabled, all keys interrupt will be turned off even though key is pressed.

Note: If KEY is set to GPIO (High) or GPIO (low) on the IO CONFIG page, the INT_EN corresponding to KEY will also be disabled.

5.6 Key Calibration

As shown in Figure 19 below,

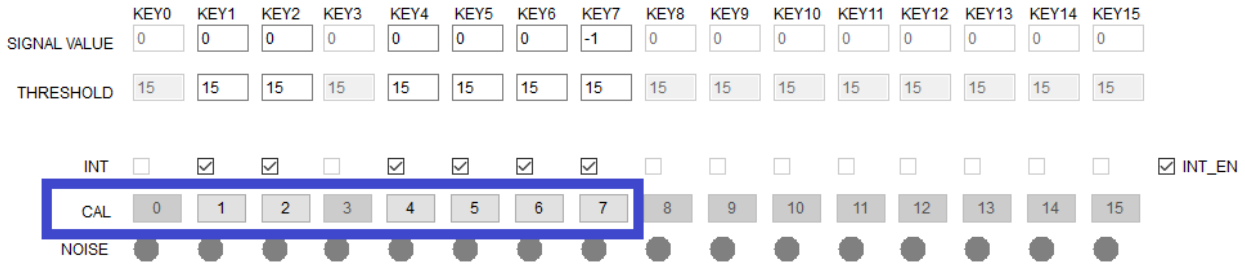

Figure 19: The calibration of the KEY

"0" in a box means KEY0 and "7" means KEY7. System will force calibrating the corresponding KEY by pressing button. Please make sure there in no action on keys during calibration, or it will cause errors.

5.7 Noise Display and Threshold Setting

As shown in Figure 20 below,

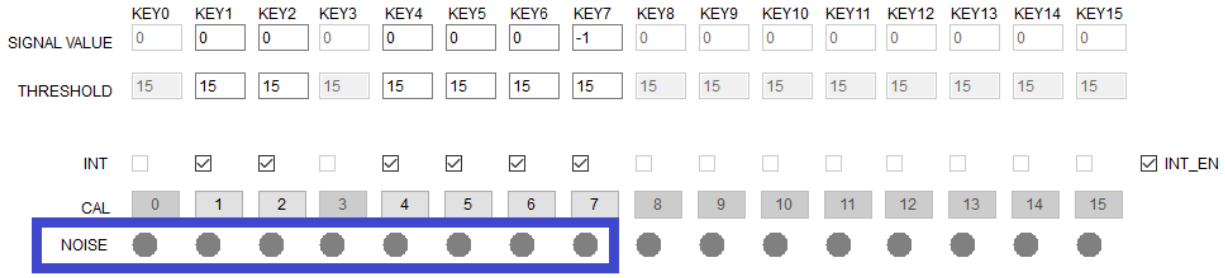

Figure 20: The noise lights of the KEY

There are 8 noise lights for KEY0~KEY7. Light will be red when the corresponding KEY has noise or it will be gray.

NOISE_TH_SET bit is noise threshold set from 0~127. Input data in the corresponding box and press Enter or Tab key, or move the cursor to another location will set up the threshold.

When the VALUE of the sample changes more than NOISE_TH_SET, but not exceeds the key threshold setting, the touch key will be considered to be an ambient noise disturbance. And corresponding noise display will turn red.

5.8 KEY Value Display

As shown in Figure 21 below, The key values are displayed in the box under each KEY.

Figure 21: The value of the KEY

As shown in the box above, the top of the dark black half box corresponds to the key threshold value, shaded gray represents the key value and the red line below represents a "negative threshold value".

Key value will be updated and corresponds to the current capacitance of the key. The signal value of KEY1 is 33 and threshold is 15. As the signal value is greater than its threshold, KEY1 is triggered and displayed in red.

6. SETTING-1

As shown in Figure 22 below, the touch key related parameters are set as follows.

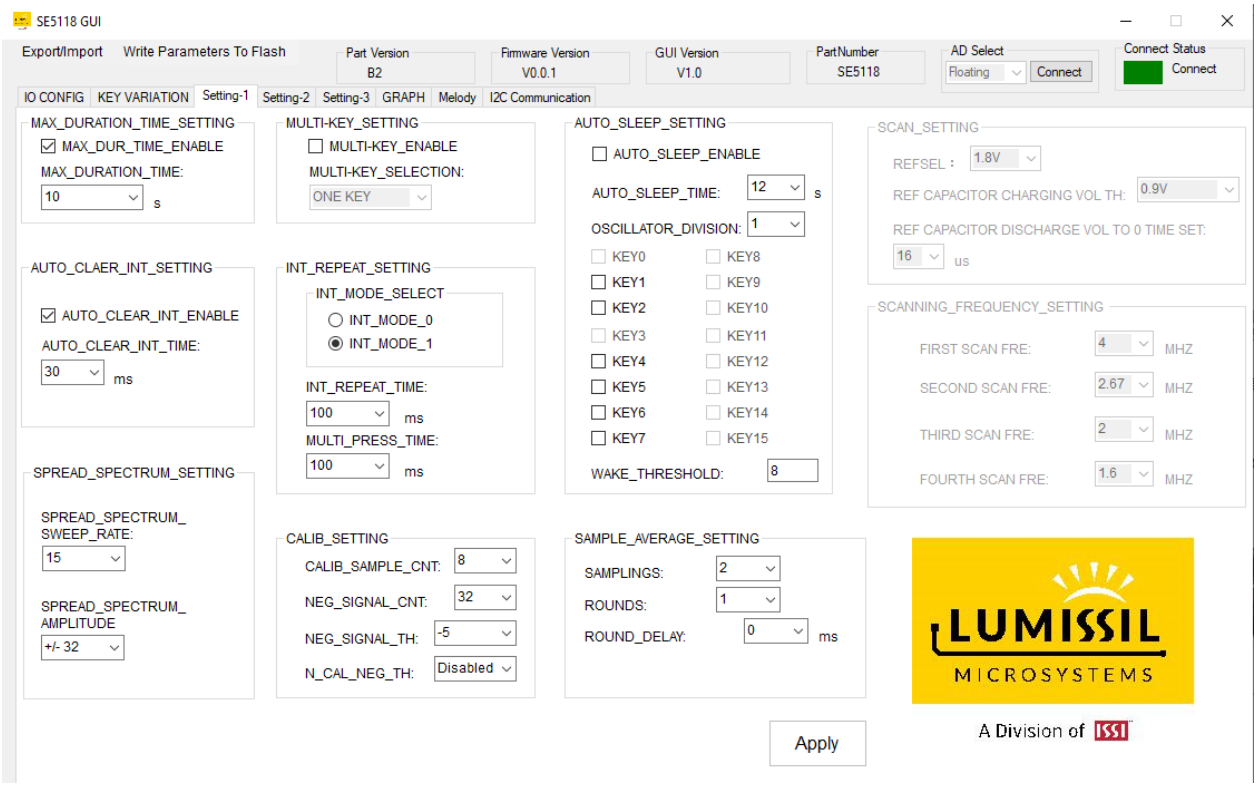

Figure 22: Setting page of GUI

6.1 MAX_DURATION_TIME_SET：Maximum Pressing Duration Time Setting

As shown in Figure 23 below,

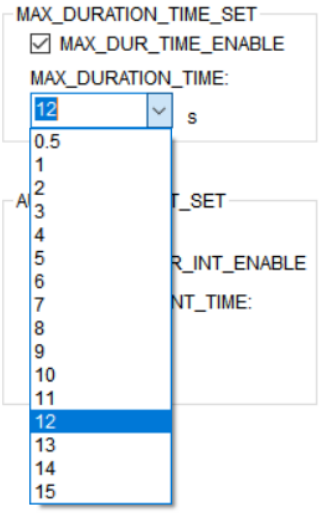

Figure 23: MAX_DURATION_TIME_SET option

MAX_DUR_ENABLE is the maximum pressing duration time function enable. Checking is enable, no checking is disable.

MAX_DURATION_TIME is the maximum pressing duration time setting. Unit is second. When pressing time is over MAX_DUR_TIME, system will force calibrating the pressed key.

This function is mainly used to prevent a touch key from the environment factor. For example, the water drop is on the touch button, which causes the touch button keep pressing status and cannot be used again.

If the maximum pressing time is set, when the touch button is pressed over programmed time, it will be force calibration. Then the touch button can be used after being affected by the water drop.

6.2 AUTO_CLEAR_INT_SET：Auto-Clean Interrupt

As shown in Figure 24 below,

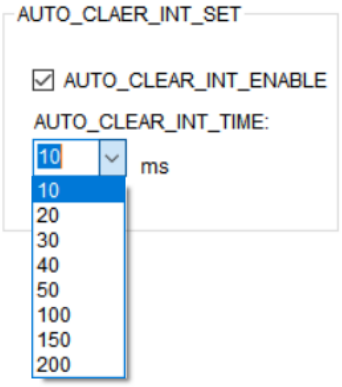

Figure 24: AUTO_CLEAR_INT_SET option

AUTO_CLEAR_INT_ENABLE is auto-clean interrupt function. Checking is enable.

AUTO_CLEAR_INT_TIME is auto-clean interrupt time to choose. Unit is milisecond.

When AUTO_CLEAR_INT_ENABLE is disabled, only reading 02h and 03h registers will releae the INTB pin, otherwise it will keep low.

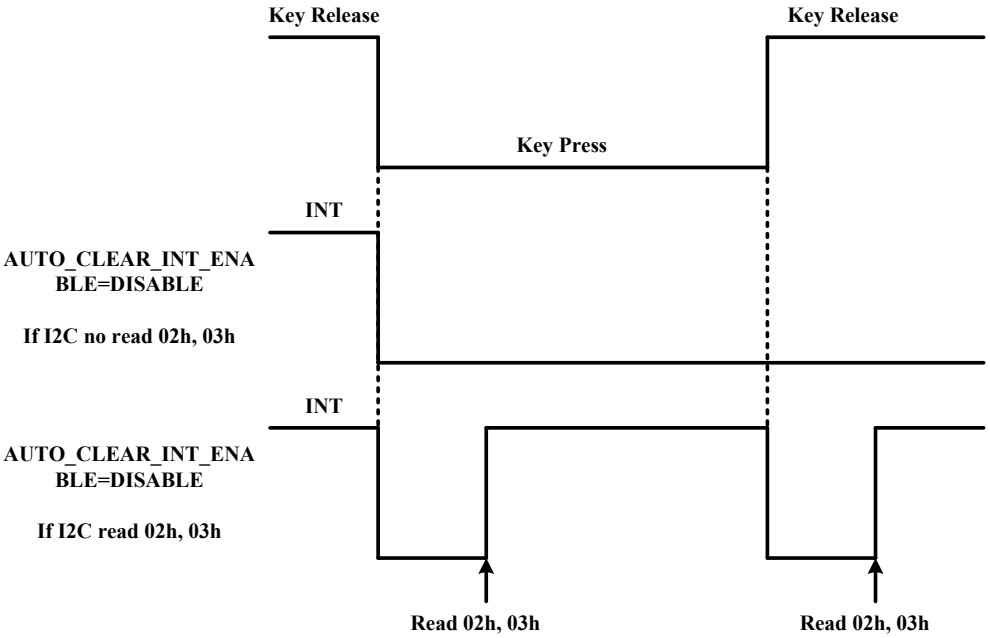

Figure 25: INTB action when AUTO_CLEAR_INT_ENABLE is disabled

When AUTO_CLEAR_INT_ENABLE is enabled, INTB pin will be released by reading 02h (Key Status Register1) and 03h (Key Status Register2) registers. If 02h and 03h registers are not be read within programmed time AUTO_CLEAR_INT_TIME (10ms~200ms), then IS31SE5118 will release INTB pin after AUTO_CLEAR_INT_TIME time expired.

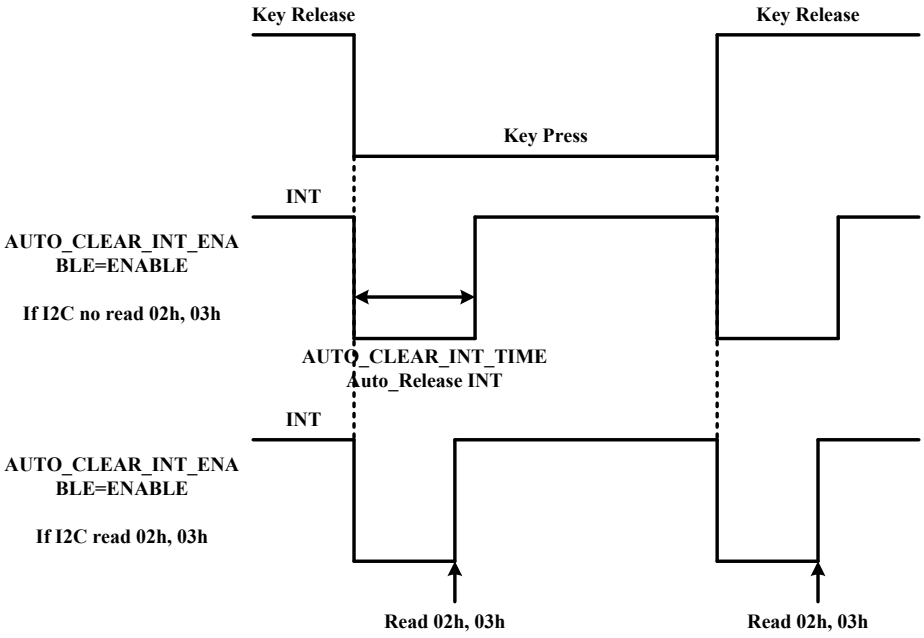

Figure 26: INT action when AUTO_CLEAR_INT_ENABLE is enabled

6.3 SPREAD_SPECTRUM_SET：Spread Spectrum Setting

As shown in Figure 27 below,

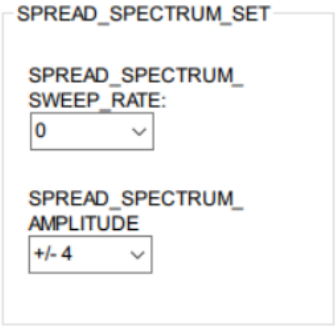

Figure 27: INTB action when AUTO_CLEAR_INT_ENABLE is enabled

SPREAD_SPECTRUM_SWEEP_RATE is defines the spread spectrum sweep rate. If SPREAD_SPECTRUM_SWEEP_RATE = 0, then the spread spectrum is disabled.

SPREAD_SPECTRUM_AMPLITUDE is defines the amplitude of spread spectrum frequency change.

The setting of spread sweep frequency and the spread amplitude should be carefully selected to reduce the effect of EMI.

6.4 MULTI-KEY_SET：Multi-Key Setting

As shown in Figure 28 below,

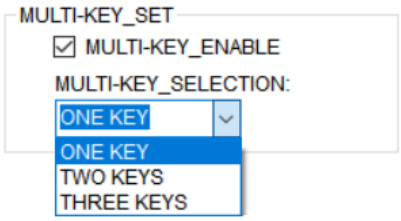

Figure 28: MULTI-KEY_SET option

MULTI-KEY_ENABLE is enabled multi-key function. Checking is enable. When MULTI-KEY_ENABLE is not checking, all keys are available.

MULTI-KEY_SELECTION can be set to ONE KEY, TWO KEYS or THREE KEYS by clicking the arrow in box. In some applications, such as a password lock, the number of keys pressed need to limit at the same time. The MULTI-KEY_SELECTION should be set to ONE KEY to prevent error on password lock.

6.5 INT_REPEAT_SET：Interrupt Repeat Setting

As shown in Figure 29 below,

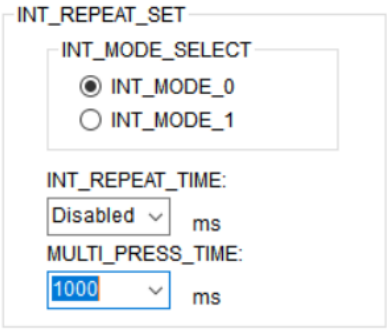

Figure 29: INT_REPEAT_SET option

INT_MODE_SELECT is INT_MODE mode setting. System generates one interrupt only by pressing or releasing keys when pick INT_MODE_0. System generates interrupt repeat by pressing keys when pick INT_MODE_1 and releasing key will trigger once interrupt.

INT_REPEAT_TIME is used to set interrupt auto-repeat time. Click arrow in bow to choose different time and unit is millisecond.

MULTI_PRESS_TIME is used to set the time between first and second interrupt. Click arrow to choose different time and unit is millisecond.

If there is a key keeping pressing, second interrupt will be generated until MULTI_PRESS_TIME after first interrupt and waiting for INT_REPEAT_TIME to trigger third interrupt and going on interrupt.

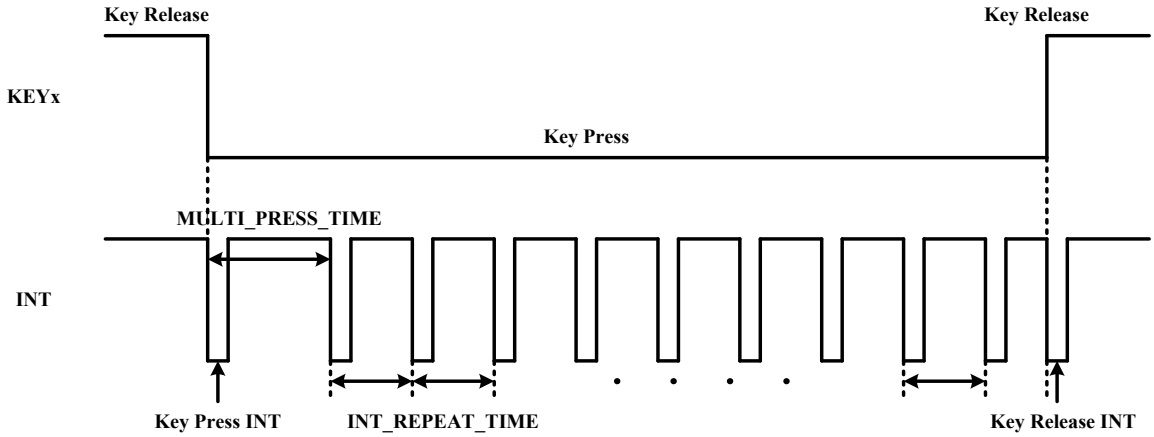

Figure 30: INT behavior when setting the INT_REPEAT_SET parameter

6.6 SAMPLE_AVERAGE_SET：Sampling Frequency and Average Number Setting

As shown in Figure 31 below,

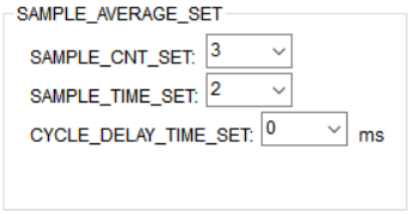

Figure 31: SAMPLE_AVERAGE_SET option

SAMPLE_CNT_SET is to set each button sampling number, the average value of multiple samples is taken as the final key value to improve the scanning stability.

SAMPLE_TIME_SET is single sampling time for SAMPLE_CNT_SET, then sampling time for each key is: SAMPLE_TIME_SET*SAMPLE_CNT_SET.

The larger value of SAMPLE_CNT_SET and SAMPLE_TIME_SET, the better the reliability of the key. However at the same time the sampling speed of the button will be slower. Please set these values according to the actual application.

CYCLE_DELAY_TIME_SET is a cycle delay time after all keys scanned.

6.7 AUTO_SLEEP_SET：Auto SLEEP Mode Setting

As shown in Figure 322 below,

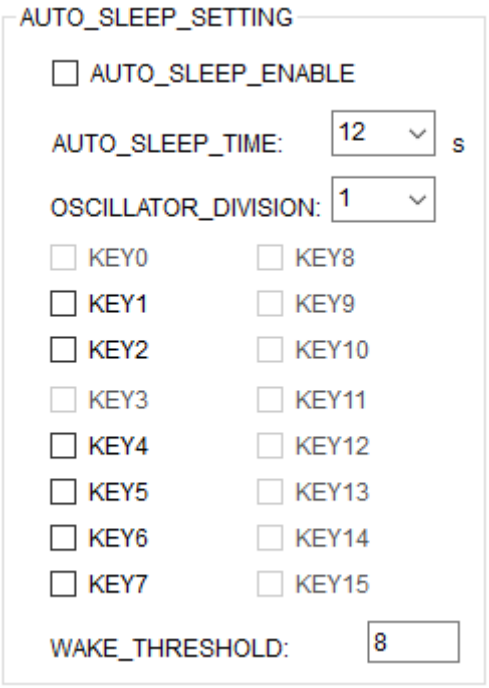

Figure 32: AUTO_SLEEP_SET option

IS31SE5118 integrates AUTO_SLEEP function and the entering time could be configured. System will enter into SLEEP Mode when no action in touch key. It will be waked up by any key action. In some applications that require low power consumption, it can be set to SLEEP mode automatically.

KEY1, KEY2, KEY4, KEY5 and KEY7 is enabled to exit SLEEP Mode (Click SLEEP button in Figure 14 to enter into SLEEP Mode in GUI interface). Enable the corresponding key and system will be waked up as key value arrives the wake up threshold (WAKE_THRESHOLD)

WAKE_THRESHOLD_SET is used to set the key threshold for waking up from SLEEP Mode. Input data in box and press Enter or Tab key, or move the cursor to another location will set up the threshold.

6.8 CALIB_SET：Calibration Setting

As shown in Figure 33 below,

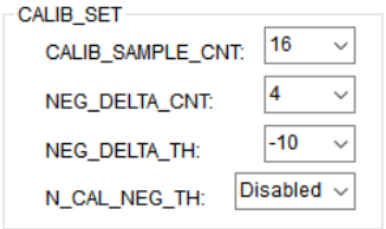

Figure 33: CALIB_SET option

CALIB_SAMPLE_CNT sets times for auto-calibrate cycle. The influence of parasitic capacitance shift on touch key will be reduced by calibrating.

When the variety of continuous sampling is negative and over the negative threshold (NEG_DELTA_TH), the corresponding key will be forced calibrating.

NEG_DELTA_TH is used to set negative threshold.

N_CAL_NEG_TH is the negative threshold for forced calibration.

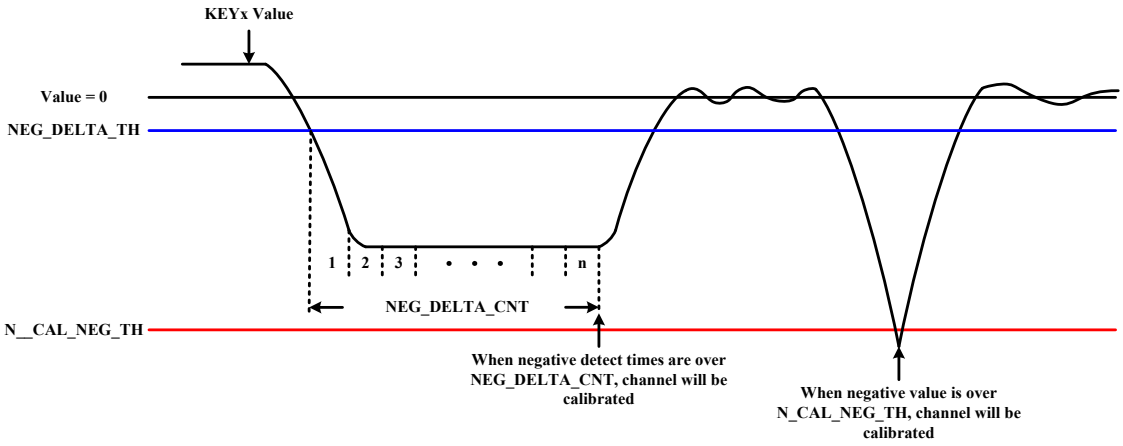

Figure 34: AUTO_SLEEP_SET option

7. SETTING-2

As shown in Figure 33 below, there's seven parameters for filter algorithm and one parameter for sleep wake up period can be set.

In the SETTIN-2 window, all the SETTING parameters must adjust to evaluation board of IS31SE5118. The customer didn't be encouraged to adjust these parameters in the SETTIN-2 window. There is another APP Note to illustrate SETTING-2 window.

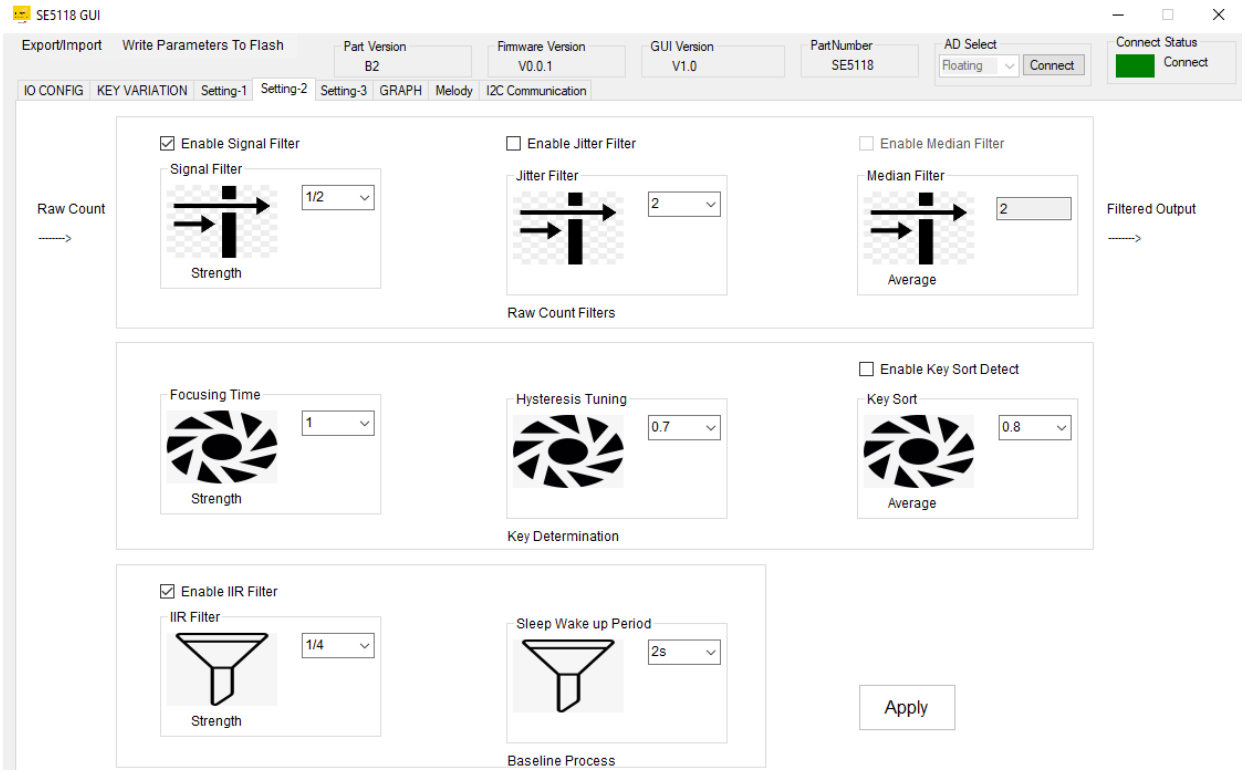

Figure 35: SETTIN-2 parameters

8. SETTING-3

As shown in Figure 33 below, TK3 stands for Touch Key technology III. It is a name for one of Touch Key technologies in Lumissil. TK3 uses dual-slope technology to design charge charging among an internal charge capacitor, an external reference capacitor and the Touch Key capacitor. Several parameters for the TK3 should be set. There is another APP Note to illustrate SETTING-3 window.

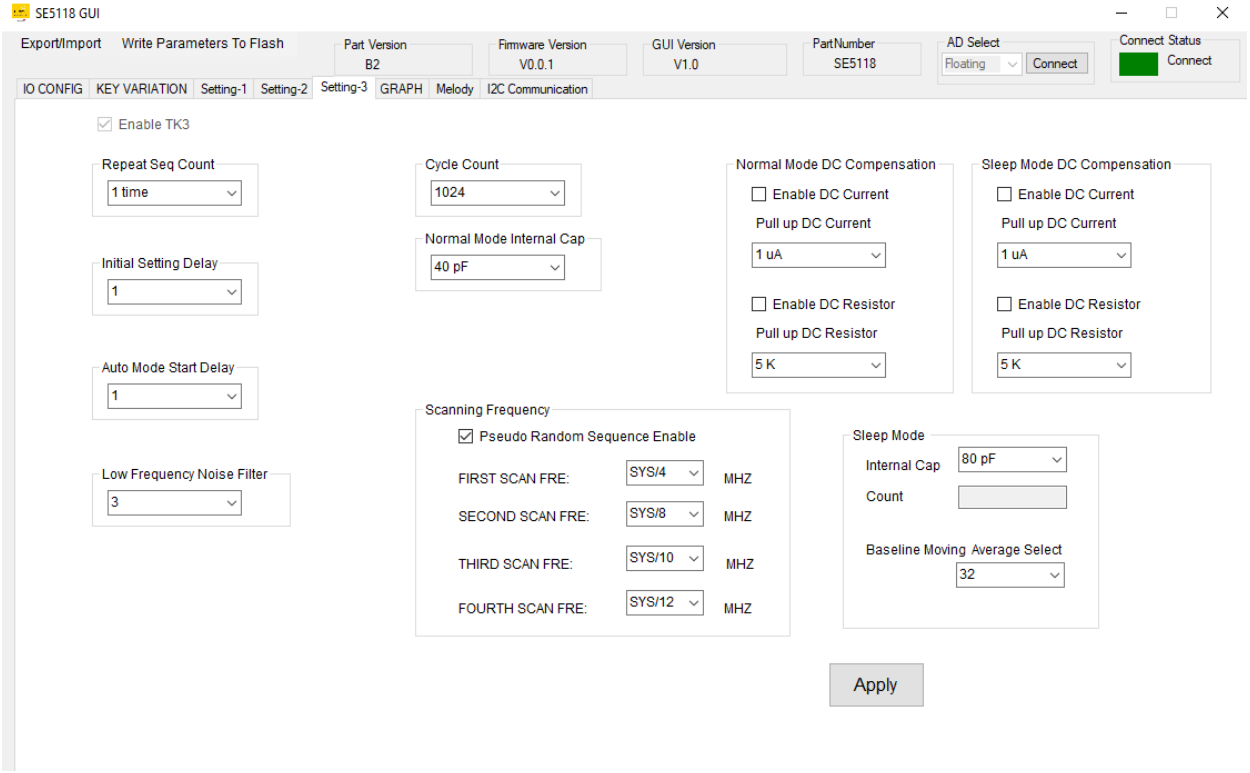

Figure 36: SETTING parameters

9. GRAPH

As shown in Figure 33 below, GRAPH is KEY value curves to show the current value of KEY0~KEY7. As shown in Figure 37, history value of KEYs will be checked by pulling the scroll bar. Users can uncheck the "KEY ENABLE" box in the lower right corner to filter out unwanted key values.

Figure 37: Display the current value of KEY on the GRAPH page

10. Melody

As shown in 8 below, the built-in melody function has 10 FIFOs, the host controller can send the melody data up to 10 notes

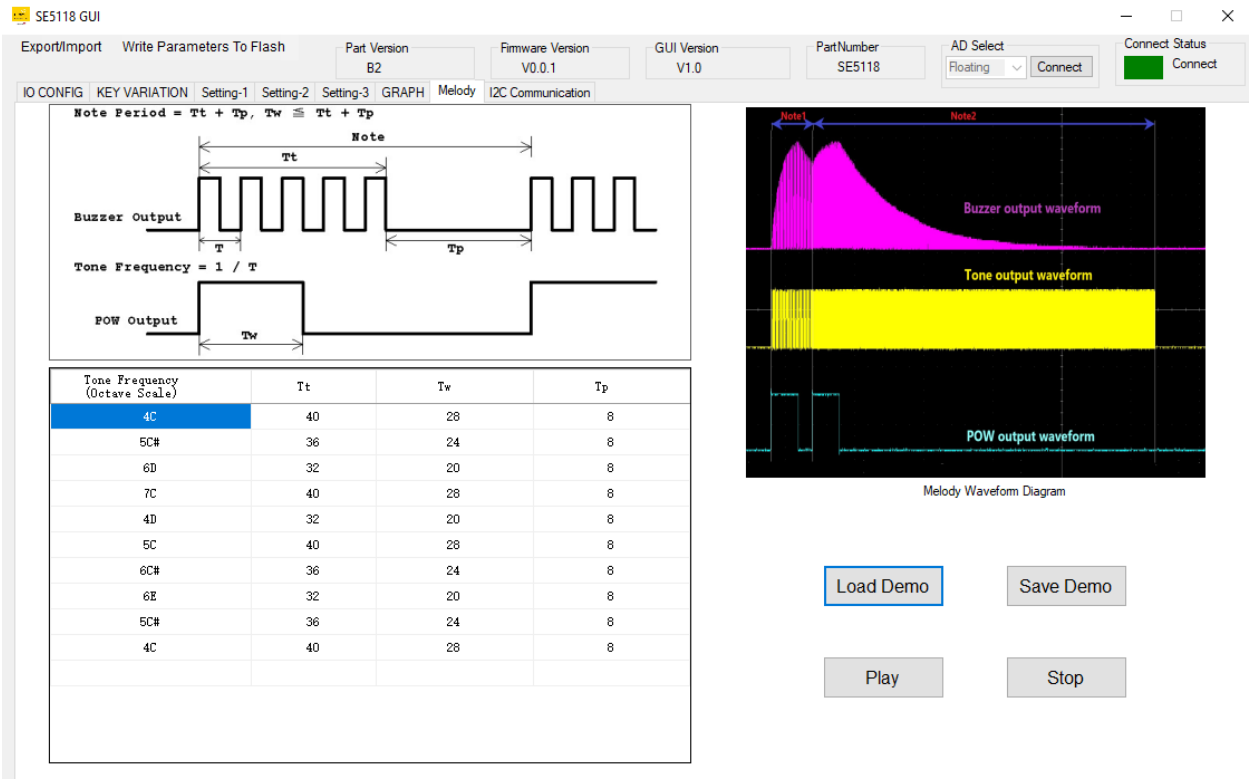

Figure 38: Melody page of GUI

The support scale from 3A to 8G#

Frequencies for equal-tempered scale, A**4** = 440 Hz "Middle C" is C4												
	3	freq	divisor	freq error	4	freq	divisor	freq error	5	freq	divisor	freq error
C					3	261.6	1911	0.01%	15	523.3	956	-0.05%
C#					4	277.2	1804	-0.01%	16	554.4	902	-0.01%
D					5	293.7	1703	-0.02%	17	587.3	851	0.04%
D#					6	311.1	1607	0.00%	18	622.3	804	-0.06%
E					7	329.6	1517	-0.01%	19	659.3	758	0.06%
F					8	349.2	1432	-0.02%	20	698.5	716	-0.02%
F#					9	370.0	1351	0.03%	21	740.0	676	-0.05%
G					10	392.0	1276	-0.04%	22	784.0	638	-0.04%
G#					11	415.3	1204	-0.01%	23	830.6	602	-0.01%
A	0	220.0	2273	-0.01%	12	440.0	1136	0.03%	24	880.0	568	0.03%
A#	1	233.1	2145	0.01%	13	466.2	1073	-0.04%	25	932.3	536	0.05%
B	2	246.9	2025	-0.01%	14	493.9	1012	0.04%	26	987.8	506	0.04%

	6	freq	divisor	freq error	7	freq	divisor	freq error	8	freq	divisor	freq error
C	27	1046.5	478	-0.05%	39	2093.0	239	-0.05%	51	4186.0	119	0.37%
C#	28	1108.7	451	-0.01%	40	2217.5	225	0.21%	52	4434.9	113	-0.23%
D	29	1174.7	426	-0.08%	41	2349.3	213	-0.08%	53	4698.6	106	0.39%
D#	30	1244.5	402	-0.06%	42	2489.0	201	-0.06%	54	4978.0	100	0.44%
E	31	1318.5	379	0.06%	43	2637.0	190	-0.21%	55	5274.0	95	-0.21%
F	32	1396.9	358	-0.02%	44	2793.8	179	-0.02%	56	5587.7	89	0.54%
F#	33	1480.0	338	-0.05%	45	2960.0	169	-0.05%	57	5919.9	84	0.55%
G	34	1568.0	319	-0.04%	46	3136.0	159	0.28%	58	6271.9	80	-0.35%
G#	35	1661.2	301	-0.01%	47	3322.4	150	0.33%	59	6644.9	75	0.33%
A	36	1760.0	284	0.03%	48	3520.0	142	0.03%				
A#	37	1864.7	268	0.05%	49	3729.3	134	0.05%				
B	38	1975.5	253	0.04%	50	3951.1	127	-0.36%				

I2C command format (each node is composed of 4 byte data, the incomplete note will be ignored)
0x78, 0xF0, (scale_id, Tt, Tw, Tp), (scale_id, Tt, Tw, Tp), ….
0x78, 0xF0, 0xFF stop the melody play and clear the FIFO

0x78, 0xF0 set the register no to 0xF0
0x79 read FIFO remain length

Scale ID 0 is 3A, 1 is 3A#, 2 is 3B ….
Tt, Tw, Tp range from 0 to 255 in 4 ms time unit

11. I2C Communication

As shown in the blue box in Figure 3939, the user can issue I2C commands to the EvB here. On the right, you can choose to load, store, send and clear actions. I2C command set can be composed of several bytes. These bytes can be separated by space or comma. I2C command set can be terminated by a line wrap.

As shown in the red box, you can choose to save or clear the data log on the right after the result of the I2C command is issued. The green box indicates the delay time setting between each command and command, the delay setting range is 10ms~1000ms.

Note: Please select the correct I2C address according to the setting of the AD pin switch on the EvB (Please refer to Table 2).

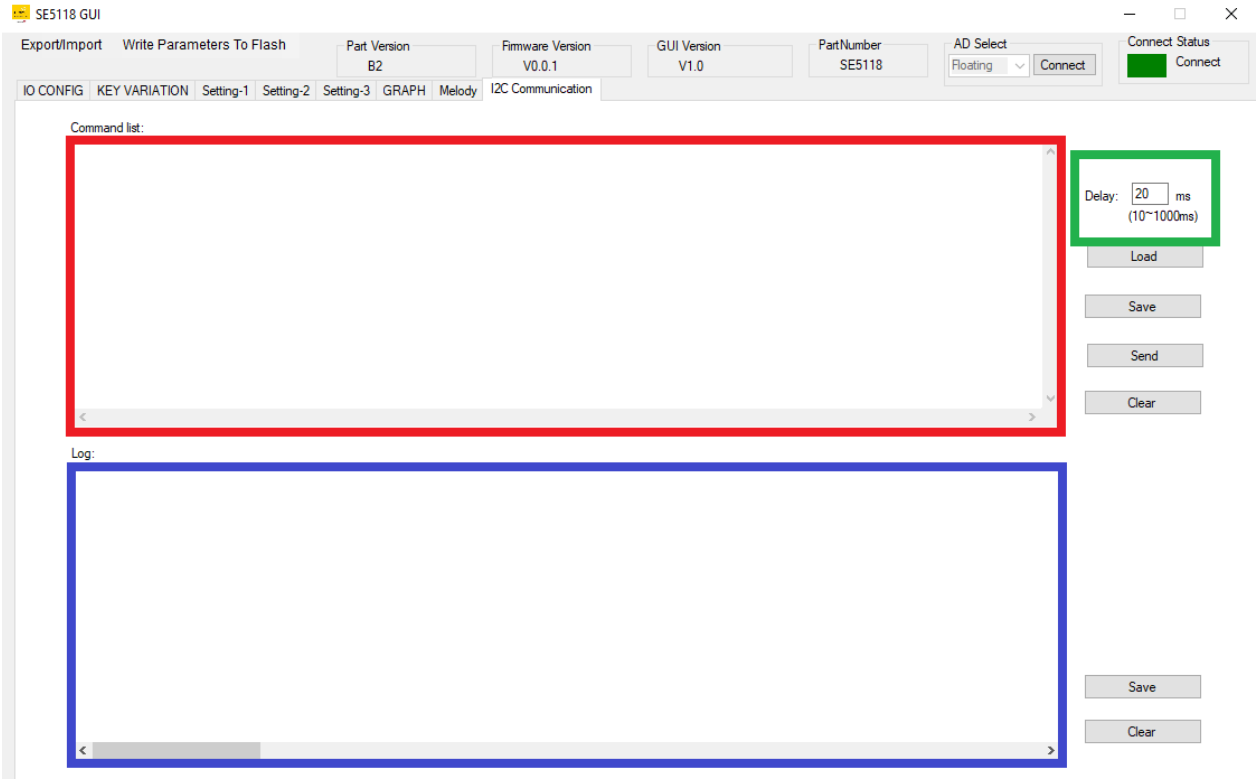

Figure 39: I2C Communication page of GUI

11.1 I2C Communication Example1 (Touch Key)

Command list:

Command	Description
78 06 0A 3C	Write data 0x0A to register no. 06
	Write data 0x3C to register no. 07
78 06	Write register no. as 06
79	Read data from register no. 06
78 07	Write register no. as 07
79	Read data from register no. 07

Log list:

Time	Direction	Command/Data	Description
22:16:45:170	>>	78 06 0A 3C	Write data 0x0A to register no. 06
			Write data 0x3C to register no. 07
22:16:45:197	>>	78 06	Write register no. as 06
22:16:45:218	<<	0A	Read data from register address 06
22:16:45:238	>>	78 07	Write register no. as 07

22:16:45:238	<<	3C	Read data from register address 07

Note: All the expressed number will be treated as hex, i.e. 16 is 22 in decimal
Note: only one bye data can be read

12. Debug Customer Target Board Based On GUI

12.1 Connection Block Diagram

As shown in Figure 400 below, the EzISP board can be connected to the customer target board to configure touch keys or LED parameters through the GUI interface.

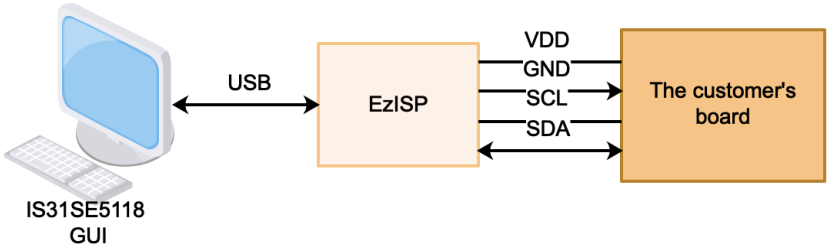

Figure 40: Block diagram of EzISP Board connected to the custom target board

As shown in Figure 411 below, the EzISP Board only needs 4 pins to connect to the custom target board, which are VDD, GND, SCL, and SDA.

Figure 41: Pin configuration on EzISP board

12.2 Customer Target Board Configuration by GUI

First, you can use the GUI interface to connect to the customer's target board to adjust the parameters of the touch keys and set the LED pattern without having to develop code in the customer's MCU at the beginning. This can shorten development time.