HY313X EVA Test Tool
User Manual (for HY3131-AK02)

Table of Contents

Attention：

1. HYCON Technology Corp. reserves the right to change the content of this datasheet without further notice. For most up-to-date information, please constantly visit our website: http://www.hycontek.com .
2. HYCON Technology Corp. is not responsible for problems caused by figures or application circuits narrated herein whose related industrial properties belong to third parties.
3. Specifications of any HYCON Technology Corp. products detailed or contained herein stipulate the performance, characteristics, and functions of the specified products in the independent state. We does not guarantee of the performance, characteristics, and functions of the specified products as placed in the customer's products or equipment. Constant and sufficient verification and evaluation is highly advised.
4. Please note the operating conditions of input voltage, output voltage and load current and ensure the IC internal power consumption does not exceed that of package tolerance. HYCON Technology Corp. assumes no responsibility for equipment failures that resulted from using products at values that exceed, even momentarily, rated values listed in products specifications of HYCON products specified herein.
5. Notwithstanding this product has built-in ESD protection circuit, please do not exert excessive static electricity to protection circuit.
6. Products specified or contained herein cannot be employed in applications which require extremely high levels of reliability, such as device or equipment affecting the human body, health/medical equipments, security systems, or any apparatus installed in aircrafts and other vehicles.
7. Despite the fact that HYCON Technology Corp. endeavors to enhance product quality as well as reliability in every possible way, failure or malfunction of semiconductor products may happen. Hence, users are strongly recommended to comply with safety design including redundancy and fire-precaution equipments to prevent any accidents and fires that may follow.
8. Use of the information described herein for other purposes and/or reproduction or copying without the permission of HYCON Technology Corp. is strictly prohibited.

1. Package Contents

HY3131-AK02 is a HY3131 ENOB ΣΔADC performance test tool, as shown in Figure 1-1. You can use HY3131-AK02 to evaluate the basic functions of DMM (Digital Multifunction Meters) (such as voltage, resistance, current and other related performance evaluation). The following are Packaging contents description:

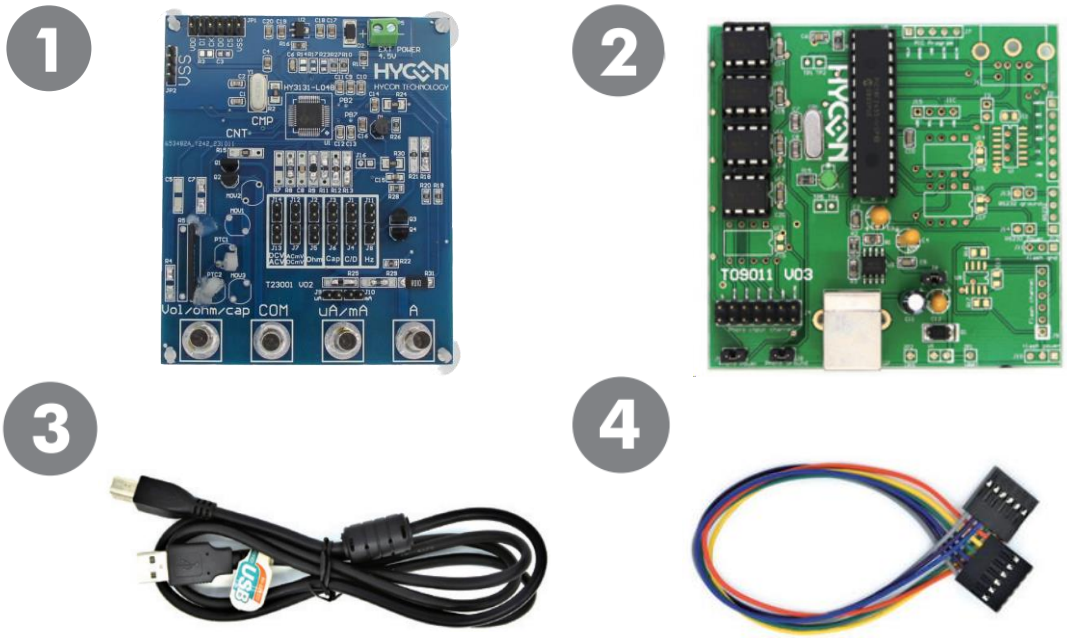


圖 1-1

No.	Model No.	Description	Quantity
HY3131-AK02	1. HY3131-AK02	HY3131 Target Board	1
	2. HY31300-CM01	HY3131 ENOB Control Board	1
	3. Cable line	USB Type A to Type B Cable	1
	4. Interface line	6pin/2.54(2.54mm pitch)	1

2. Safety Precautions

- Do not place heavy objects on the display panel, in order to avoid damage caused by stress.
- Place the application display boards at steady place, so as to avoid falling damage.
- Do not use this product with the input voltage which is not meeting the electrical specifications, in order to avoid working abnormally or damage.
- Avoid application display boards being touched by liquid, dirt and avoid being exposed to moisture during operation. This application should be kept in a dry environment, so as not to affect the function and performance.
- Remove the power supply when not using it.
- When following status occurred, please remove the power supply immediately, and contact our engineer.
  - Power Supply line is worn or damaged.
  - Power source (battery) connected but no any light on while operating.
  - Component off.

3. Software Installation Requirements

3.1. Minimum system requirements

1. hardware requirement

IBM PC compatible X86 system CPU

32MB Memory（256MB recommended）

VGA 1024×768 or above resolution, 256 color display

10MB Hard disk

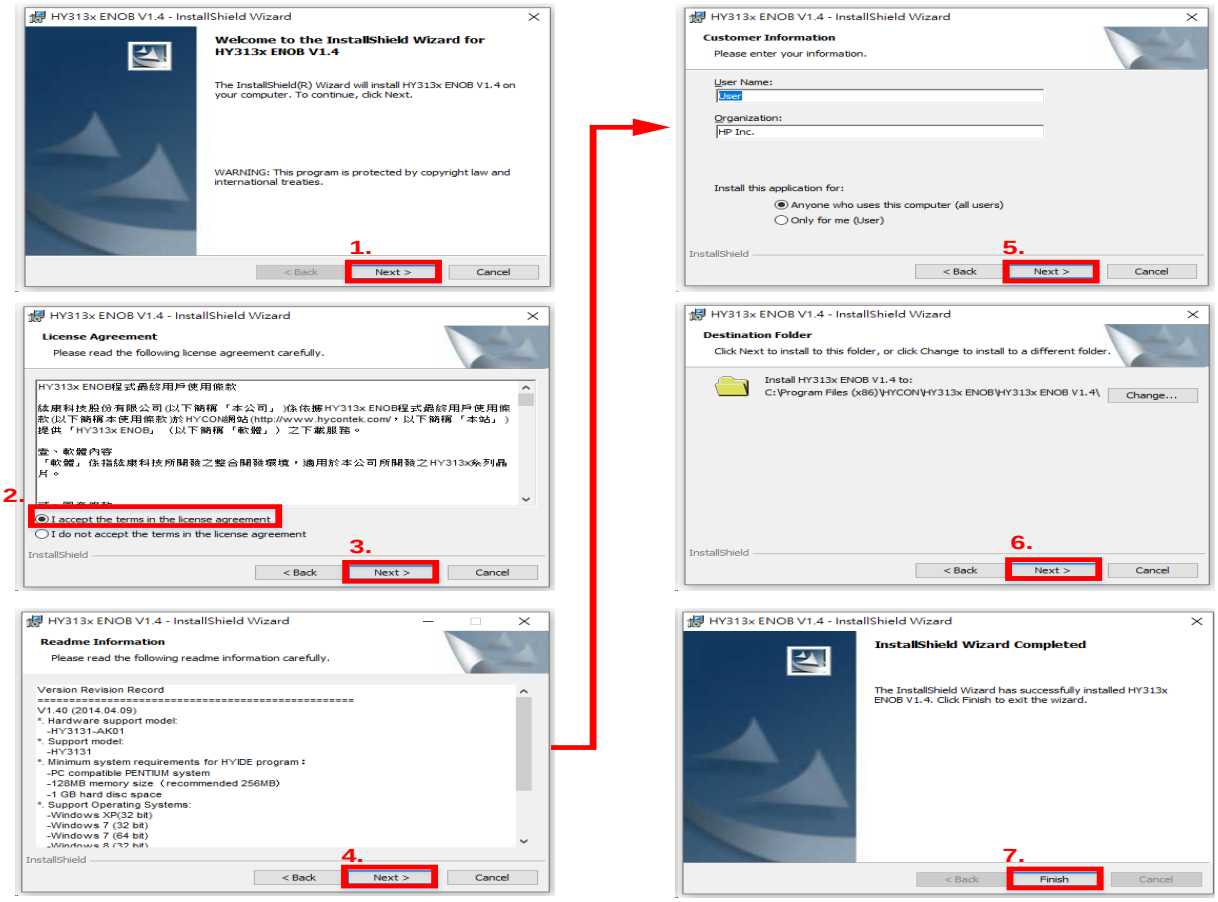
USB Port

2. Operating system

Windows™ 2000,Windows™ XP, Windows™ Vista, Windows™ 7,Windows™ 10

3.2. Software installation

3.2.1. Software installation steps instructions



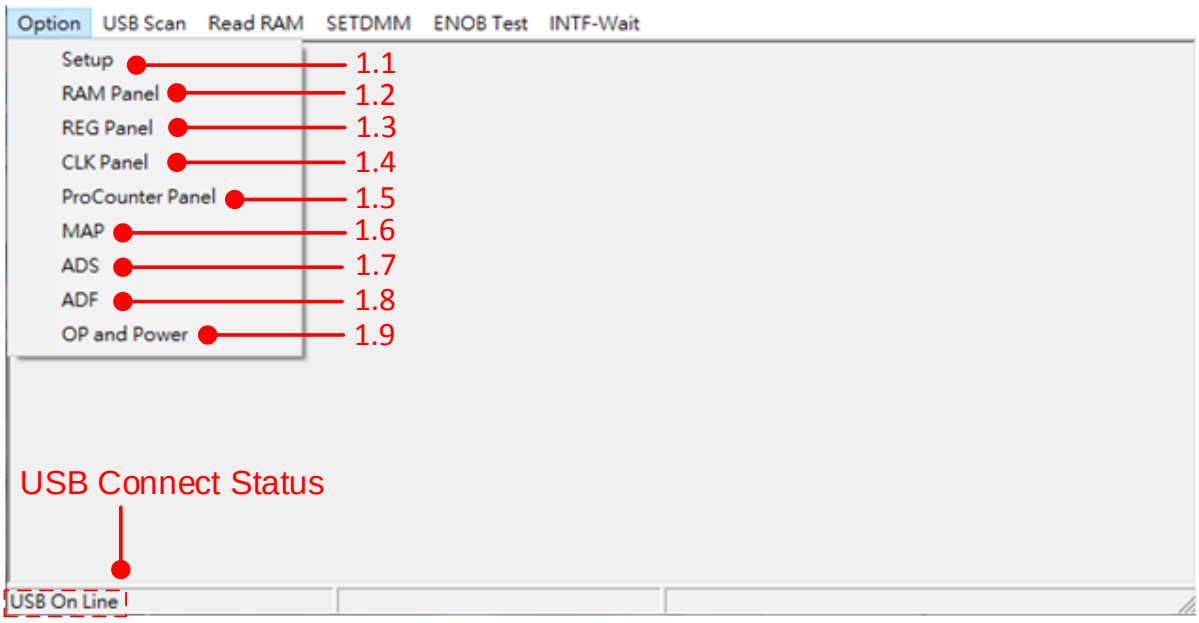
4. Software menu description

HY3131-DMM software introduction

Item Number	Name	Description
1	Option	Configuration and function window
2	USB Scan	Connect USB
3	Read RAM	Read all register status of HY3131
4	SETDMM	Set DMM function window
5	ENOB Test	ADC ENOB test window
6	INTF-Reading	Read setting of interrupt flag

4.1. Setting Options

Item Number	Name	Description
1.1	Setup	Control interface configuration
1.2	RAM Panel	Memory panel
1.3	REG Panel	Register panel
1.4	CLK Panel	System clock panel
1.5	ProCounter Panel	Frequency counter panel
1.6	MAP	DMM network panel
1.7	ADS	AD1 panel
1.8	ADF	AD2 & AD3 panel
1.9	OP and Power	OPA & Power panel

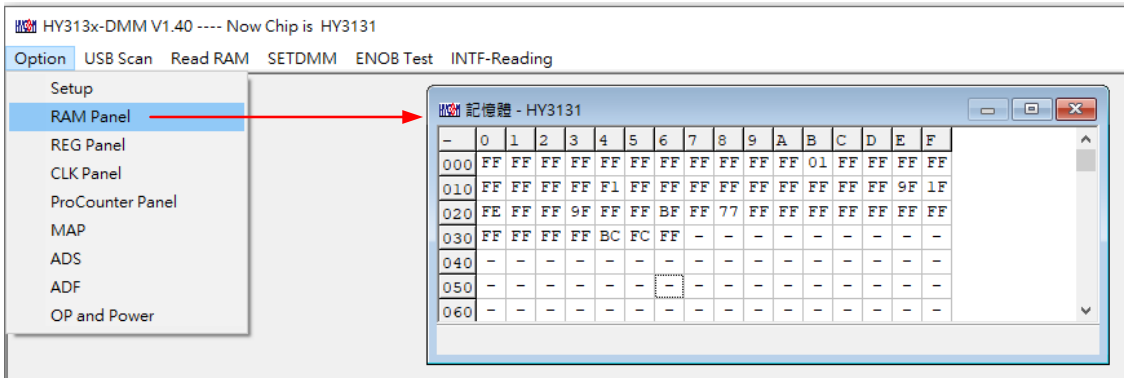


4.1.1. Setup

When using the test tool to connect to the HY3131, the chip type and communication mode are fixed, and the user does not need to make additional selections.

4.1.2. RAM Panel

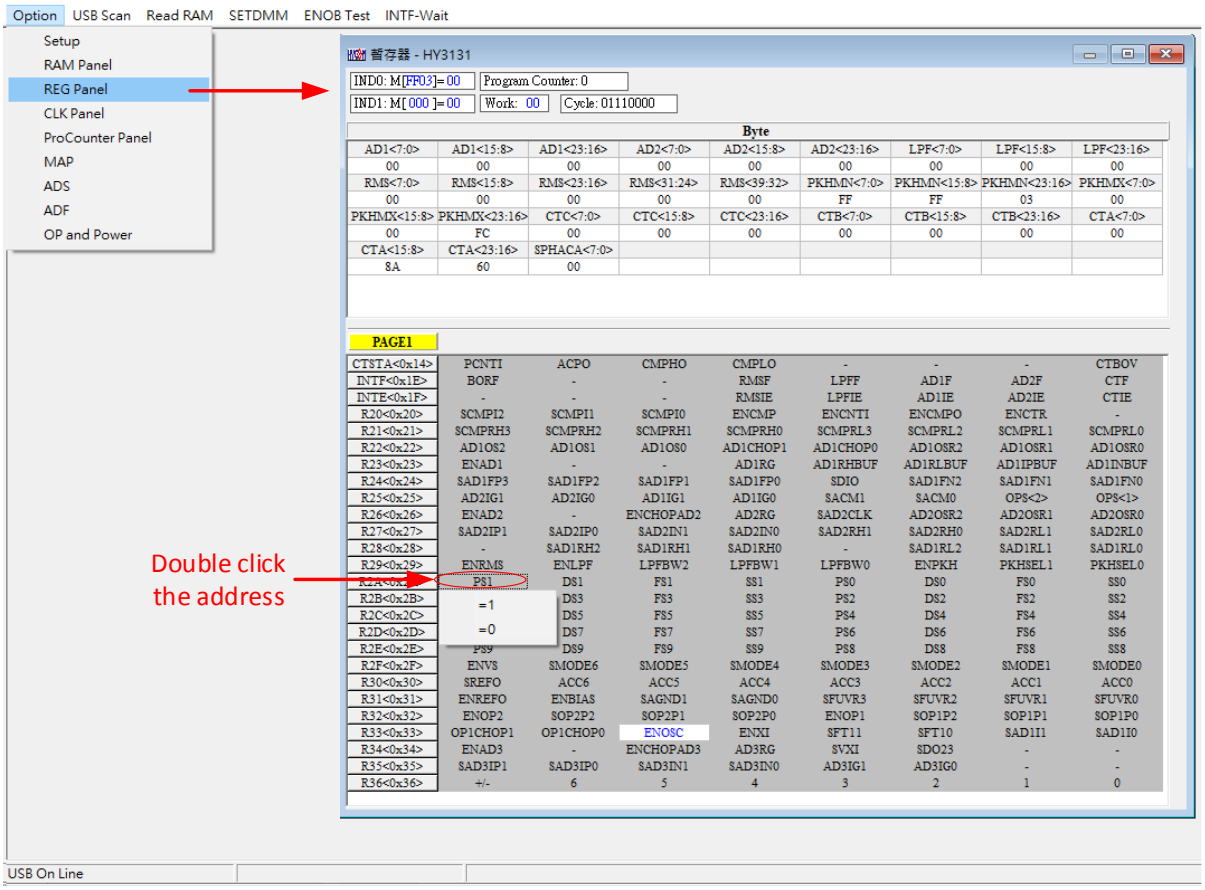
If you want to modify the RAM value, you can double-click the left button on the address to display a window for modifying the value in the address.



4.1.3. REG Panel

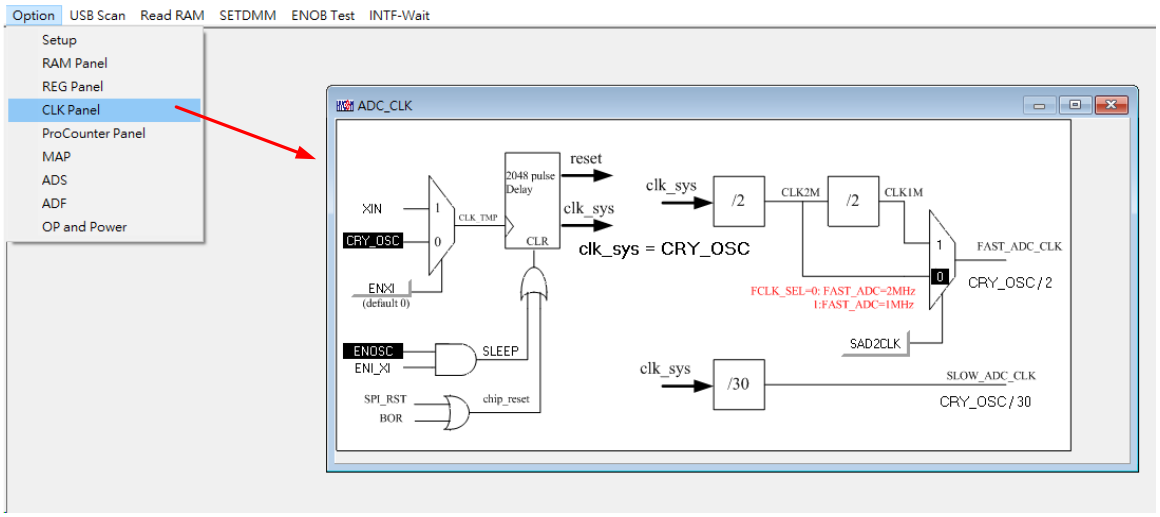
If you only need to modify one Bit, point the mouse to the modified Bit position, click the left button of the mouse to display the options =1 and =0, select 1 or 0.

The color of the Panel word is blue on a white background, indicating that the Bit is 1, otherwise it is 0.



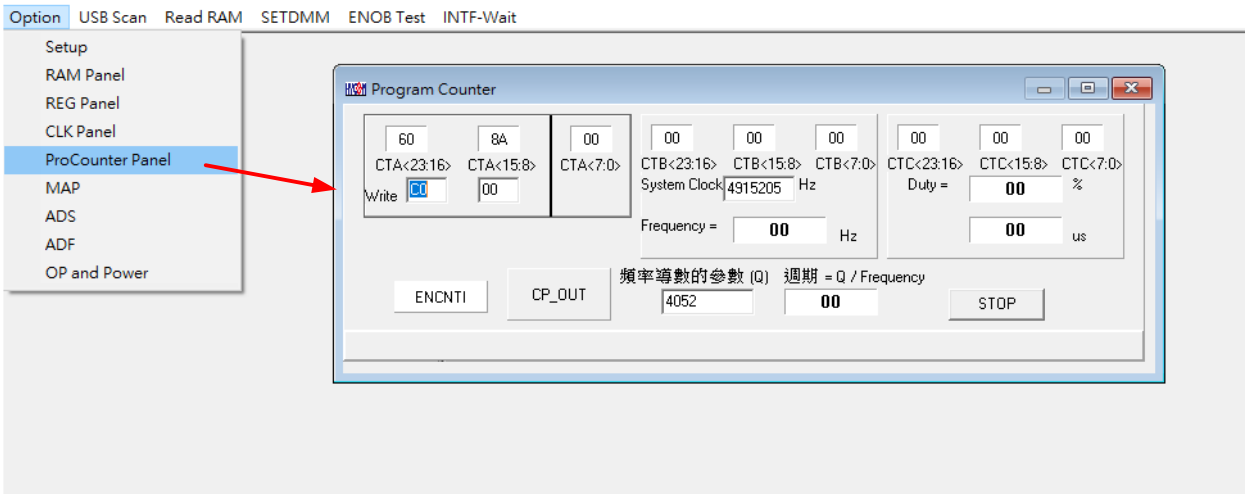
4.1.4. CLK Panel

The clock source of the ADC can be selected through the panel.



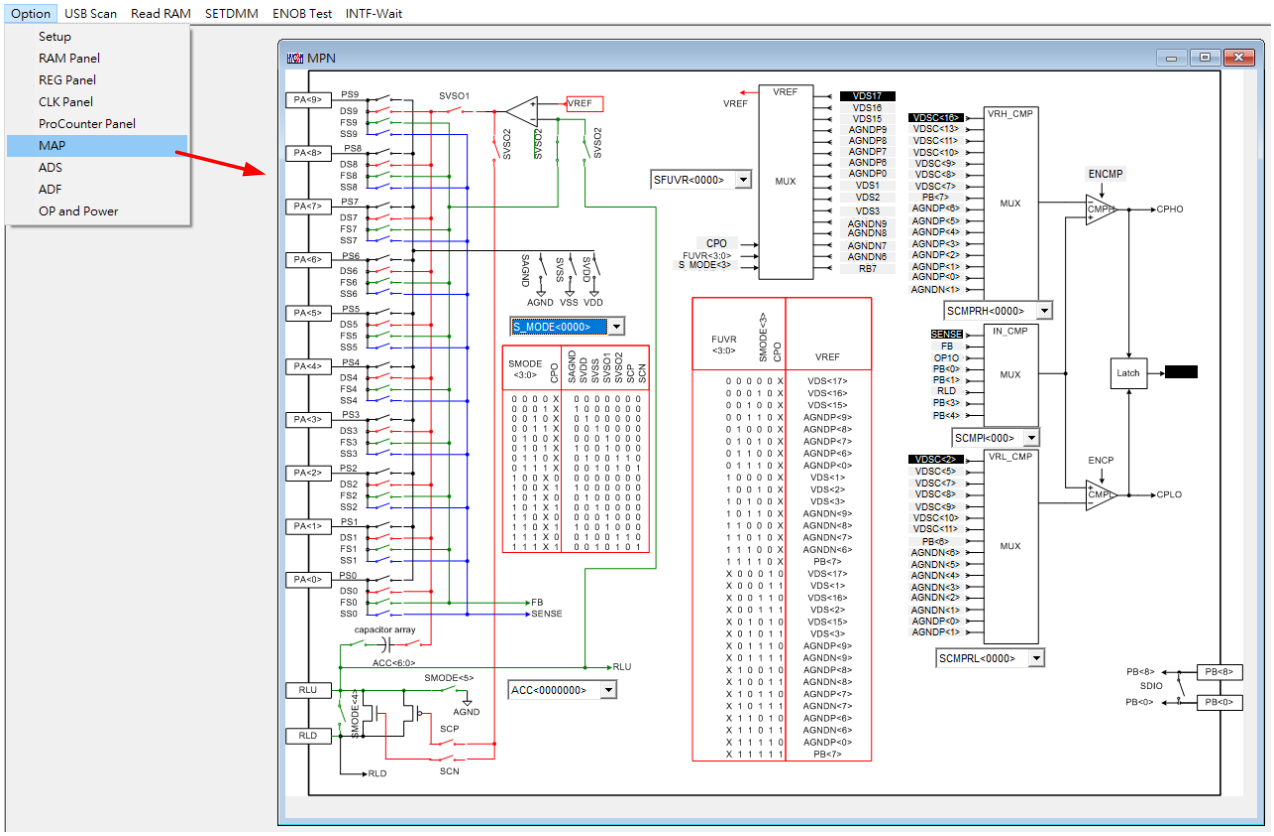
4.1.5. ProCounter Panel

Frequency measurement & capacitance measurement can check the performance through this panel.



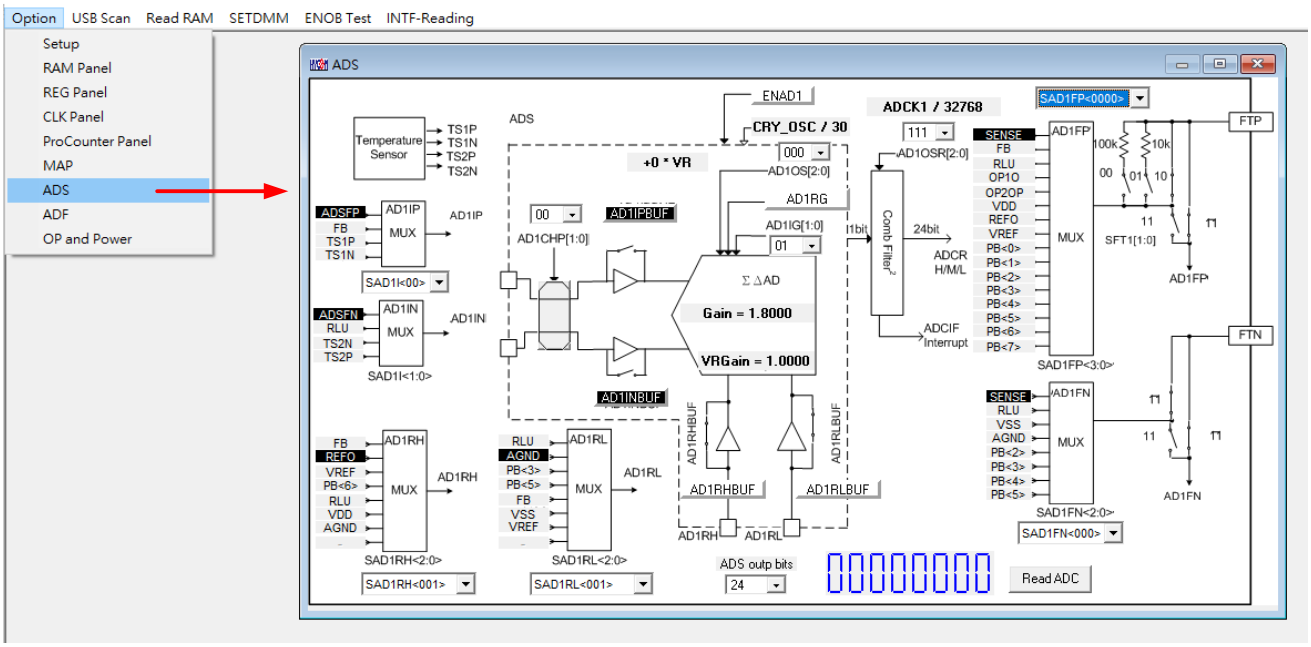
4.1.6. MAP

Multi-function network switch (used in voltage, resistor, diode and other applications), please refer to HY313x configuration setting (APD-DMM003).



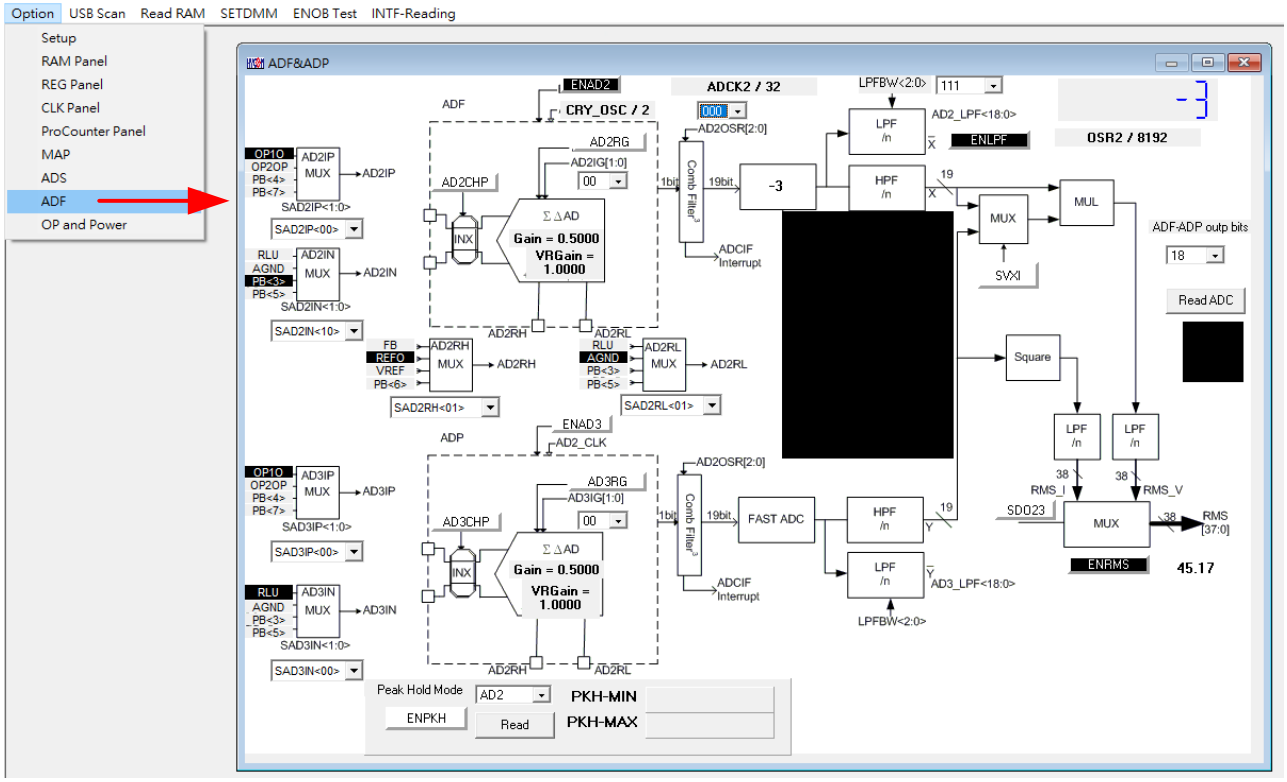
4.1.7. ADS

AD1 panel is mainly used for DC signal measurement.



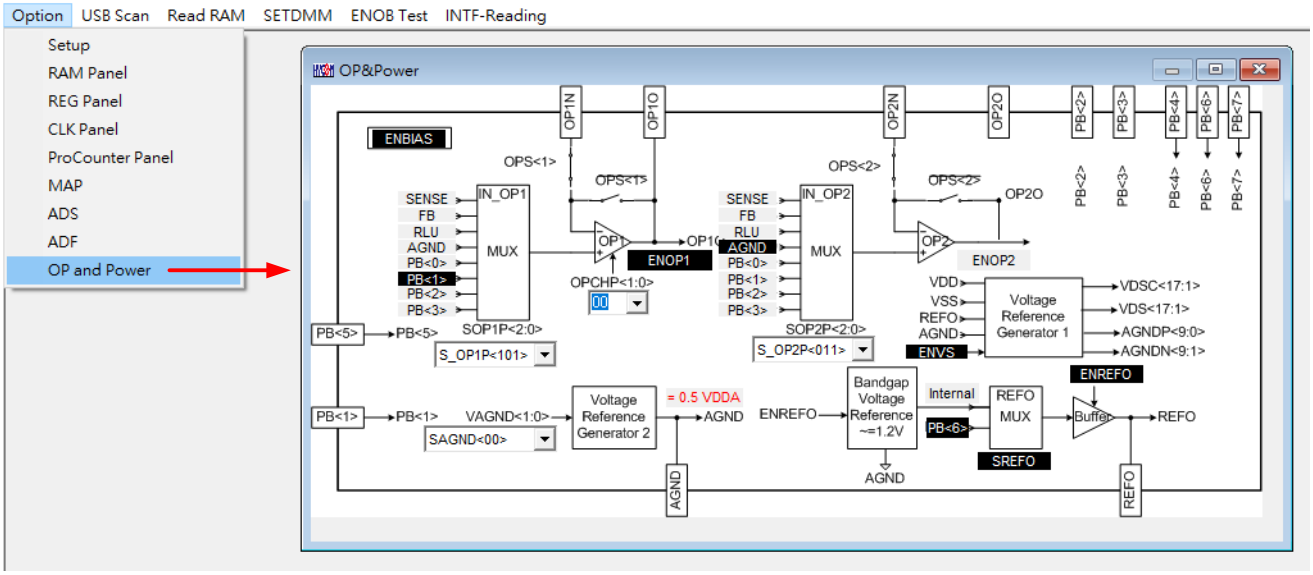
4.1.8. ADF

AD2&AD3 panel, mainly used for AC signal measurement.



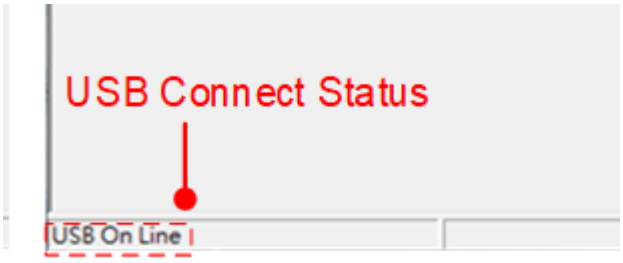
4.1.9. OP and Power

HY3131 OPA & Power panel.



4.2. USB Scan

Detect and scan the status of USB communication port and ENOB Control Board. If USB is connected, USB on Line will be displayed in the lower left corner, as shown in the figure below:

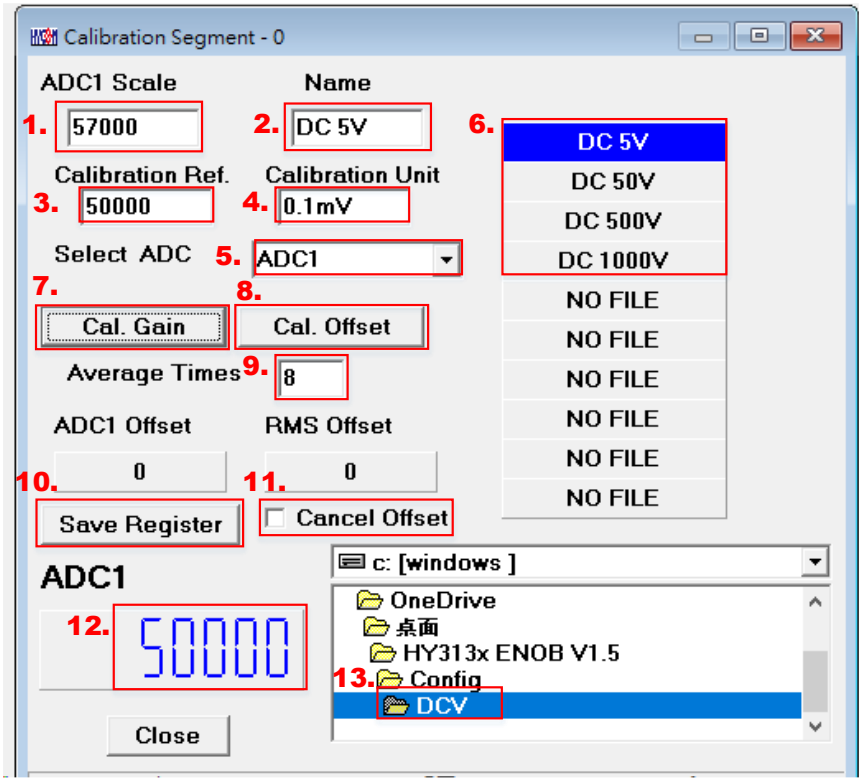


4.3. Read RAM

After executing USB Scan and confirming USB on Line, please execute Read RAM again. All the current RAM and Registers of the chip will be read into the computer's buffer. This will affect the RMS Noise and Peak-to-Peak of ENOB Test. Noise operations.

4.4. SETDMM

Example DCV 5V range loading and calibration settings



Item Number	Name	Description
1	ADC1 Scale	Set upper limit value display OL (ADC resolution)
2	Name	Currently selected name
3	Calibration Ref.	Calibration parameters (i.e., correct displayed values)
4	Calibration Unit	Calibrated unit (the smallest unit currently displayed is 0.1mV)
5	Select ADC	ADC1 or RMS(ADC2) can be selected
6	Function Range	Range selection of function
7	Cal. Gain	Save Cal. Gain button
8	Cal.Offset	Save Cal.Offset button
9	Average Times	Average times
10	Save Register	Save current register configuration
11	Cancel Offset	Check this box to enable the software to deduct the Cal.Offset value.
12	Display	Displays the current value (corrected value)
13	Function File	function file

4.5. ENOB Test

The RMS Noise generated by the Sigma Delta ADC itself is the minimum voltage value that can distinguish the sampling signal. Therefore, ENOB (Effective Number of Bits, effective output bit number) is calculated using the ratio of RMS Noise and Full Scale Range. However, RMS Noise needs to sample multiple pieces of data for averaging. If the number of samples is too small, it can only show the RMS Noise for that period of time, but cannot represent the RMS Noise of the overall ADC operation. Therefore, the number of RMS Noise calculations is not expected to be small. The number of transactions is 1024.

But if the Count output by the ADC value does not scroll, it is Noise Free Bits. Therefore, Noise Free Bits is the stable output performance of the ADC. The defined Bits operation is the ratio of Peak-to-Peak Noise and Full Scale Range.

RMS Noise is calculated as follows:

$$\text{平均Count} \rightarrow \text{Average} = \frac{\sum_{k=1}^{n} \text{ADC}[k]}{n} \quad (1)$$

$$\text{RMS Noise} = \frac{V_{RFE} \times \sqrt{\frac{\sum_{k=1}^{n} \left(\text{ADC}[k] - \text{Average}\right)^2}{n}}}{2^{\text{Scale}}} \quad (2)$$

In the above equation, n is the total number of samples of the ADC, and Scale is the total number of bits (Bits) output by the ADC. Put Equation 1 and Equation 2 into the following equation to obtain the ENOB and Noise Free Bits of the system:

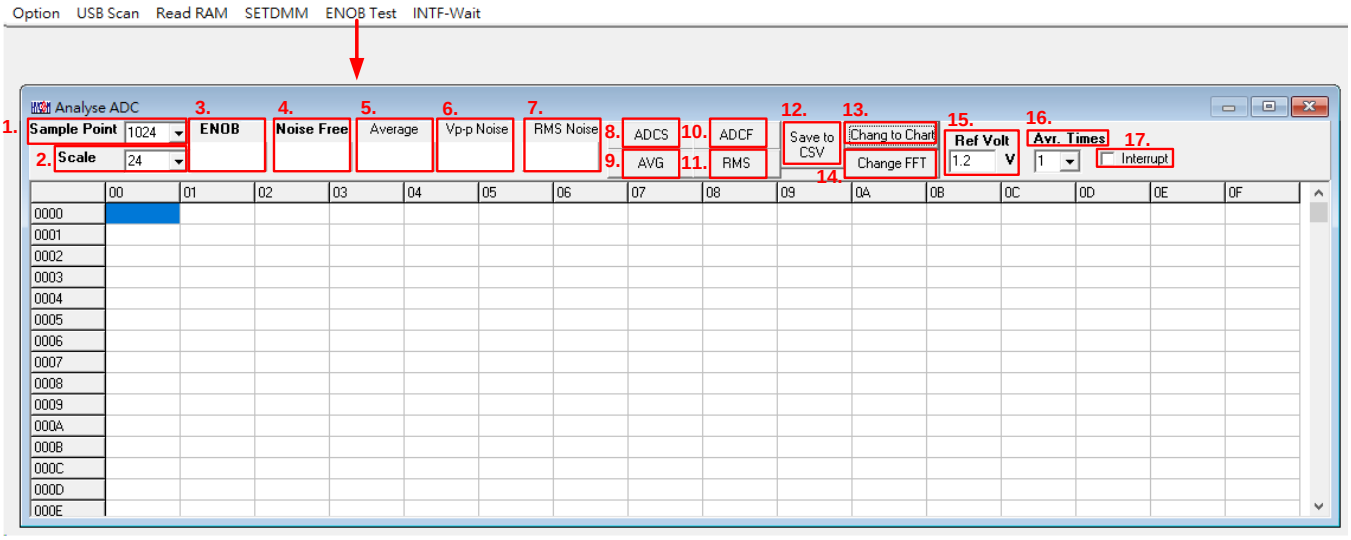
$$\text{ENOB} = Log_2\left(\frac{\text{FSR}}{\text{RMS Noise}}\right) = \frac{In\left(\frac{\text{FSR}}{\text{RMS Noise}}\right)}{In(2)} \quad (3)$$

$$\text{Noise Free Bits} = Log_2\left(\frac{\text{FSR}}{\text{Peak - to - Peak Noise}}\right) = \frac{In\left(\frac{\text{FSR}}{\text{Peak - to - Peak Noise}}\right)}{In(2)} \quad (4)$$

The calculation method of Peak-to-Peak Noise is as follows:

$$\text{Peak - to - Peak Noise} = \frac{V_{REF} \times \left(\text{ADC}_{Max} - \text{ADC}_{Min}\right)}{2^{\text{Scale}}} \quad (5)$$

ENOB Test Page description:



Item Number	Name	Description
1	**Sample Point**	Number of ADC sampling points: The minimum selectable range is 64 and the maximum is 65536.
2	**Sclae**	Number of ADC output bits: minimum 8Bits, maximum 24Bits.
3	**ENOB**	Display ENOB, calculated through the above equation 3, the unit is Bits.
4	**Noise Free**	Display Noise Free Bits, calculated by the above equation 4, the unit is Bits.
5	**Average**	Displays the sampling average of the ADC, as shown in Equation 1, the unit is Counts
6	**V_{p-p} Noise**	Displays Peak-to-Peak Noise, as shown in Equation 5, in nV.
7	**RMS Noise**	Displays RMS Noise, as in Equation 2, in nV.
8	**ADCS**	Capture and sequentially display the AD1 value in the numerical display area.
9	**AVG**	Capture and sequentially display AVG values in the value display area.
10	**ADCF**	Capture and sequentially display AD2 values in the numerical display area.
11	**RMS**	Capture and sequentially display RMS values in the numerical display area.
12	**Save to CSV**	Save the values in the display area to *.CSV files, including ENOB, Noise Free, Average, Vp-p Noise and RMS Noise.

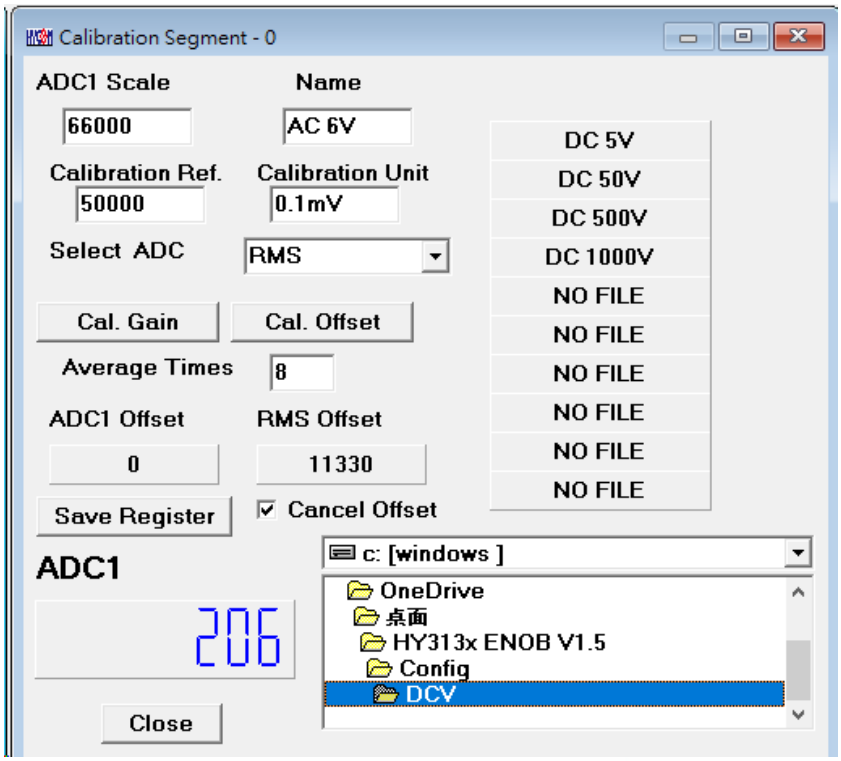
Item Number	Name	Description
13	**Change to Chart**	Switch between graphs and numerical values in the numerical display area.
14	**Change FFT**	Charts can be displayed in time domain or frequency domain.
15	**Ref Volt**	Enter Reference Voltage (unit V)
16	**Avr. Times**	Select software average, and the values in the numerical display area will be averaged according to the selected number of times, and then displayed in the numerical display area.
17	**Interrupt**	Checking the box will pause real-time capture. When unchecked, real-time capture will continue.

4.6. INTF-Wait

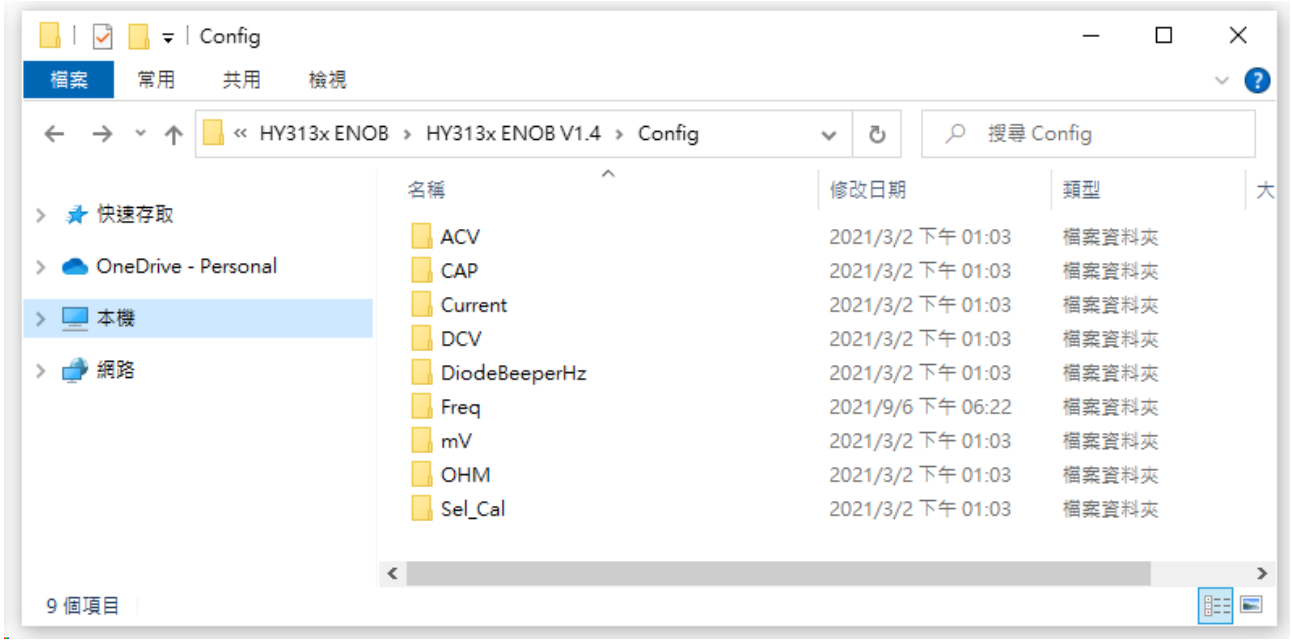
If continuous reading of the ADC is enabled, the INTF flag is read when it is INTF-reading. When an event occurs, the reading value is updated.

5. SETDMM

Users can save the register configuration file through the SETDMM dialog box and test the performance of each Range in the calibrated state. (Please refer to Chapter 4.4 for instructions)



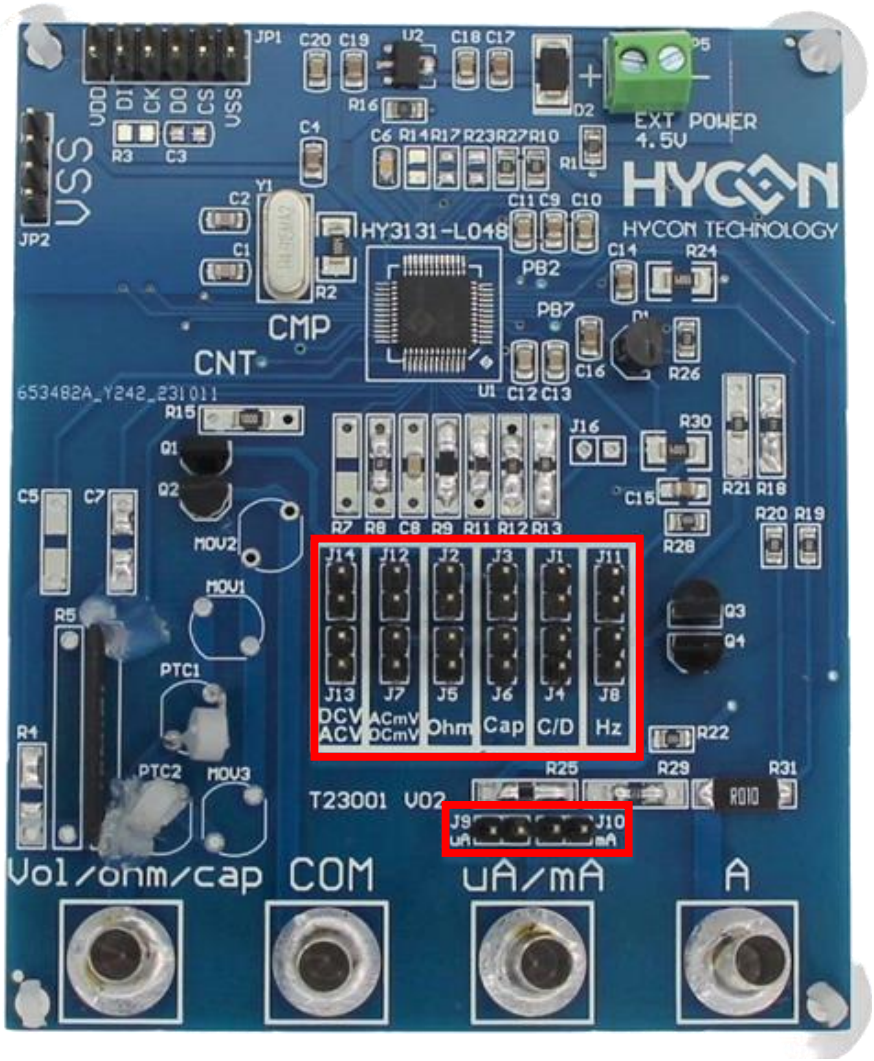
First, you can set the path to the various Range settings provided by HYCON in the installation directory.



- Set the Jumper on the HY3131 Target Board according to different functions:

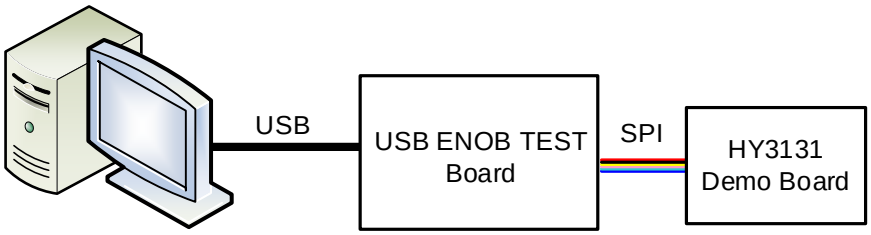
Function	Jumper1	Jumper2
DC/AC V	J13	J14
DC/AC mV	J7	J12
Resistor	J2	J5
Capacitor	J3	J6
Continuity/Diode	J1	J4
Frequency(CNT Input)	J8	J11
DC/AC uA	J9	-
DC/AC mA	J10	-
DC/AC A	-	-

Note: - means not to use

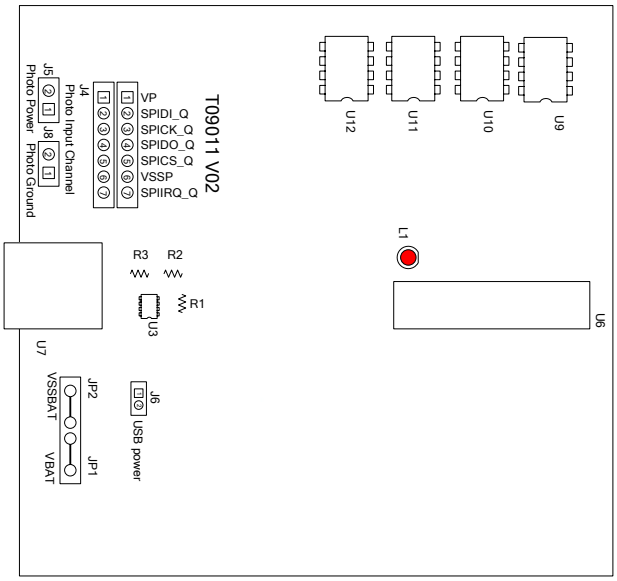


6. Hardware description

The overall architecture sends the Command from the PC to the USB ENOB Test Board, and then the USB ENOB Test Board sets and reads the values obtained by the ADC on the Hycon HY3131 Demo Board through SPI.



6.1. HY3131 ENOB Control Board description



- J4：Optical Coupler SPI port

  J4 description

  PIN 1 → VP, powered by optical coupler IC (U8~U13), J5 and J8 must be opened to completely isolate power. J5 and J8 must be short to use common power supply.

  PIN 2 → SPIDI_Q, optical coupler DI signal wire.

  PIN 3 → SPICK_Q, optical coupler CK signal wire.

  PIN 4 → SPIDO_Q, optical coupler DO signal wire

  PIN 5 → SPICS_Q, optical coupler CS signal wire.

  PIN 6 → VSSP, optical coupler Ground.

- JP1、JP2、J6、U3: Power Supply Circuit

  JP1 and JP2 is external power input that supply power to U3 and generates VDD power. Using USB power, J6 is short circuit. Using external 5V power, JP1 and JP2 inputs, J6 is open circuit. Regulated circuit that composed by U3, R1, R2 and R3 generates VDD power. Amending R1, R2 and R3 can change output voltage, the relation is as follows:

$$VDD = 1.240V \times \left(1 + \frac{R1 + R2}{R3}\right)$$

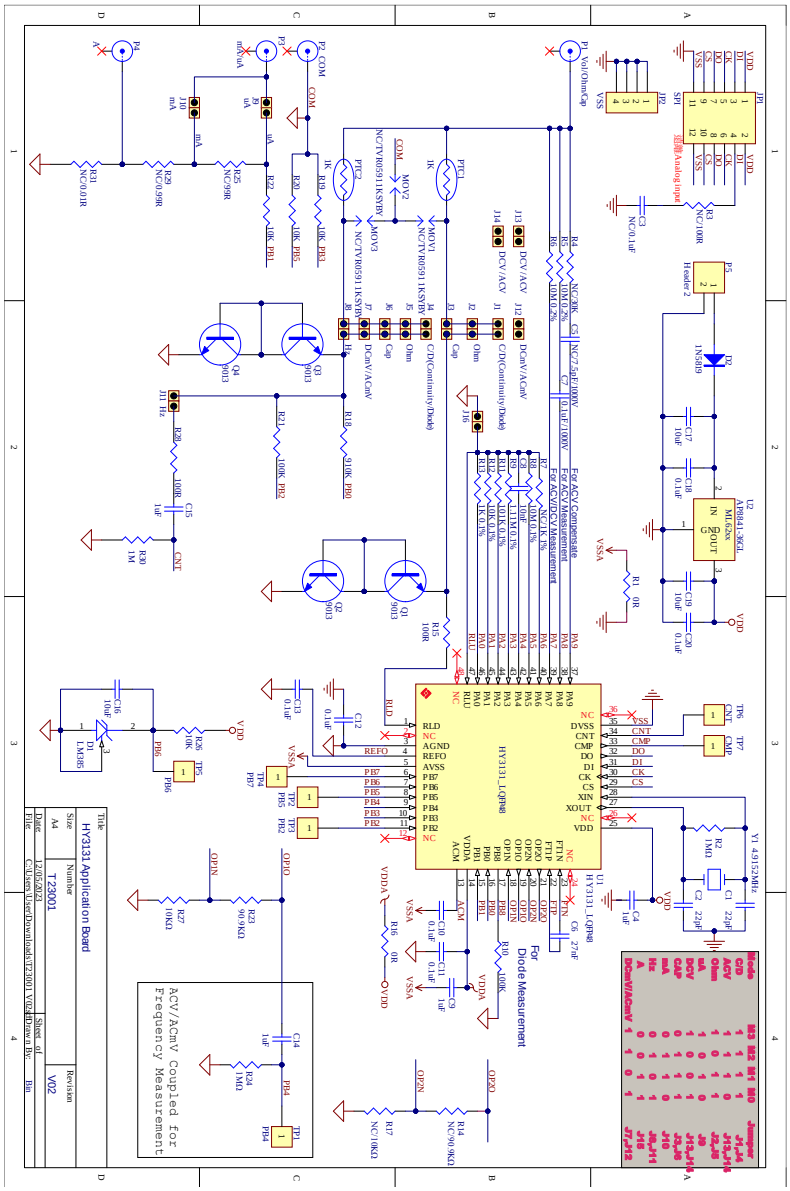
- U9、U10、U11、U12：

  Optical coupler IC components.

- U7：USB port

  Port connecting to PC, is the power source of entire system (5V), 500mA input.

6.2. HY3131 Target Board Description



7. Question Obviation

1. Registers cannot be configured under ADC window?

Communication way and IC selection must be configured first. After executing USB Scan and Read RAM, ADC register value can be configured. If USB is connected and confirmed, configuration still cannot be implemented, please close program and remove USB. After plug in the USB, execute the program again.

2. Configuration of ADC window is relatively slow?

Please do not change any setup when ADC reads data, this might bring about unpredictable results.

3. Can the data obtained include time?

Data obtained from the program ludes file that be save s CSV form but not including time. Users can detect the X-axis represent time in graphical display mode, demonstrating in ms. Time recording function will be incorporated in next version of program update.

4. **Program cannot be executed, file lack appears and program demands to reinstall.**

Please print the error window and message and please contact the distributor who provided this DMM EVA Test Tool to you or directly contact HYCON Technology for further support. We are sorry for the inconvenience this has caused to you.

5. INF error shows up when USB drive program is under installation or is completed and a yellow exclamation mark appears in “device manager”.

Please copy all programs of Driver file in the installation menu

C :\windows\system32\drivers. Reinstall driving program again. If error shows up again,

please contact the distributor who provided this DMM EVA Test Tool to you or directly contact HYCON Technology for further support.

8. Revision Record

Major differences are stated thereinafter:

Version	Page	Date	Revision Summary
V01	ALL	2024/06/07	First edition 1. Modify HY3131-AK02. 2. Modify the description SETDMM function field.