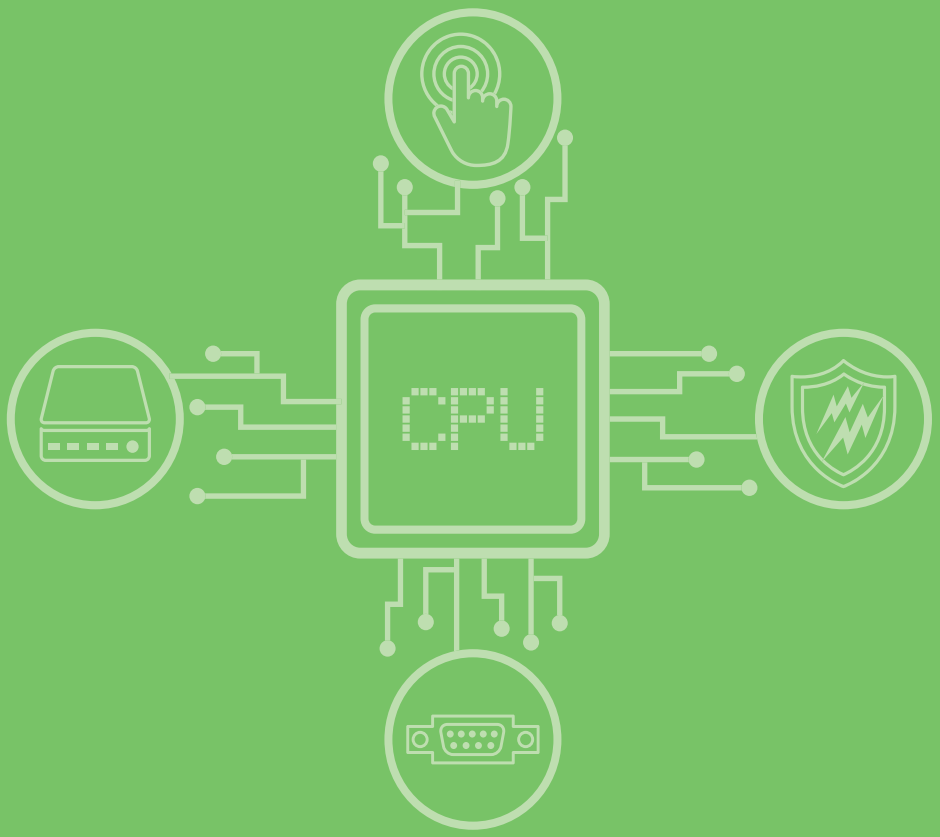


User Manual

EzBuilder

ADVANTECH

Enabling an Intelligent Planet

Copyright

The documentation and the software included with this product are copyrighted 2018 by Advantech Co., Ltd. All rights are reserved. Advantech Co., Ltd. reserves the right to make improvements in the products described in this manual at any time without notice. No part of this manual may be reproduced, copied, translated or transmitted in any form or by any means without the prior written permission of Advantech Co., Ltd. Information provided in this manual is intended to be accurate and reliable. However, Advantech Co., Ltd. assumes no responsibility for its use, nor for any infringements of the rights of third parties, which may result from its use.

Acknowledgements

Intel and Pentium are trademarks of Intel Corporation.

Microsoft Windows and MS-DOS are registered trademarks of Microsoft Corp.

All other product names or trademarks are properties of their respective owners.

Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

Part No. 2003EZBU00 Edition 1

Printed in Taiwan January 2019

Declaration of Conformity

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

CE

This product has passed the CE test for environmental specifications. Test conditions for passing included the equipment being operated within an industrial enclosure. In order to protect the product from being damaged by ESD (Electrostatic Discharge) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products.

FCC Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Class B

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FM

This equipment has passed the FM certification. According to the National Fire Protection Association, work sites are classified into different classes, divisions and groups, based on hazard considerations. This equipment is compliant with the specifications of Class I, Division 2, Groups A, B, C and D indoor hazards.

Technical Support and Assistance

1. Visit the Advantech web site at www.advantech.com/support where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (operating system, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

Warnings, Cautions and Notes

Warning! *Warnings indicate conditions, which if not observed, can cause personal injury!*

Caution! *Cautions are included to help you avoid damaging hardware or losing data. e.g.*

There is a danger of a new battery exploding if it is incorrectly installed. Do not attempt to recharge, force open, or heat the battery. Replace the battery only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.

Note! *Notes provide optional additional information.*

Document Feedback

To assist us in making improvements to this manual, we would welcome comments and constructive criticism. Please send all such - in writing to: support@advantech.com

Packing List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, please contact your dealer immediately.

- Item XXXXXXXX
- Box XXXXXXXXX

Safety Instructions

1. Read these safety instructions carefully.
2. Keep this User Manual for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
12. Never pour any liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If one of the following situations arises, get the equipment checked by service personnel:
15. The power cord or plug is damaged.
16. Liquid has penetrated into the equipment.
17. The equipment has been exposed to moisture.
18. The equipment does not work well, or you cannot get it to work according to the user's manual.
19. The equipment has been dropped and damaged.
20. The equipment has obvious signs of breakage.
21. DO NOT LEAVE THIS EQUIPMENT IN AN ENVIRONMENT WHERE THE STORAGE TEMPERATURE MAY GO BELOW -20° C (-4° F) OR ABOVE 60° C (140° F). THIS COULD DAMAGE THE EQUIPMENT. THE EQUIPMENT SHOULD BE IN A CONTROLLED ENVIRONMENT.
22. CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER, DISCARD USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.
23. The sound pressure level at the operator's position according to IEC 704-1:1982 is no more than 70 dB (A).

DISCLAIMER: This set of instructions is given according to IEC 704-1. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

Wichtige Sicherheishinweise

1. Bitte lesen sie Sich diese Hinweise sorgfältig durch.
2. Heben Sie diese Anleitung für den späteren Gebrauch auf.
3. Vor jedem Reinigen ist das Gerät vom Stromnetz zu trennen. Verwenden Sie Keine Flüssig-oder Aerosolreiniger. Am besten dient ein angefeuchtetes Tuch zur Reinigung.
4. Die NetzanschluBsteckdose soll nahe dem Gerät angebracht und leicht zugänglich sein.
5. Das Gerät ist vor Feuchtigkeit zu schützen.
6. Bei der Aufstellung des Gerätes ist auf sicheren Stand zu achten. Ein Kippen oder Fallen könnte Verletzungen hervorrufen.
7. Die Belüftungsöffnungen dienen zur Luftzirkulation die das Gerät vor überhitzung schützt. Sorgen Sie dafür, daB diese Öffnungen nicht abgedeckt werden.
8. Beachten Sie beim. AnschluB an das Stromnetz die AnschluBwerte.
9. Verlegen Sie die NetzanschluBleitung so, daB niemand darüber fallen kann. Es sollte auch nichts auf der Leitung abgestellt werden.
10. Alle Hinweise und Warnungen die sich am Geräten befinden sind zu beachten.
11. Wird das Gerät über einen längeren Zeitraum nicht benutzt, sollten Sie es vom Stromnetz trennen. Somit wird im Falle einer Überspannung eine Beschädigung vermieden.
12. Durch die Lüftungsöffnungen dürfen niemals Gegenstände oder Flüssigkeiten in das Gerät gelangen. Dies könnte einen Brand bzw. elektrischen Schlag auslösen.
13. Öffnen Sie niemals das Gerät. Das Gerät darf aus Gründen der elektrischen Sicherheit nur von authorisiertem Servicepersonal geöffnet werden.
14. Wenn folgende Situationen auftreten ist das Gerät vom Stromnetz zu trennen und von einer qualifizierten Servicestelle zu überprüfen:
15. Netzkabel oder Netzstecker sind beschädigt.
16. Flüssigkeit ist in das Gerät eingedrungen.
17. Das Gerät war Feuchtigkeit ausgesetzt.
18. Wenn das Gerät nicht der Bedienungsanleitung entsprechend funktioniert oder Sie mit Hilfe dieser Anleitung keine Verbesserung erzielen.
19. Das Gerät ist gefallen und/oder das Gehäuse ist beschädigt.
20. Wenn das Gerät deutliche Anzeichen eines Defektes aufweist.
21. VOSICHT: Explisionsgefahr bei unsachgemaben Austausch der Batterie.Ersatz nur durch densellben order einem vom Hersteller empfohlene-mahnlichen Typ. Entsorgung gebrauchter Batterien navh Angaben des Herstellers.
22. ACHTUNG: Es besteht die Explosionsgefahr, falls die Batterie auf nicht fachmännische Weise gewechselt wird. Verfangen Sie die Batterie nur gleicher oder entsprechender Type, wie vom Hersteller empfohlen. Entsorgen Sie Batterien nach Anweisung des Herstellers.
23. Der arbeitsplatzbezogene Schalldruckpegel nach DIN 45 635 Teil 1000 beträgt 70dB(A) oder weiger.

Haftungsausschluss: Die Bedienungsanleitungen wurden entsprechend der IEC-704-1 erstellt. Advantech lehnt jegliche Verantwortung für die Richtigkeit der in diesem Zusammenhang getätigten Aussagen ab.

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.
- Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Contents

Chapter 1 Introduction 1

1.1 Description 2
1.2 Features 2
1.3 Specifications 3
1.3.1 Image Acquisition 3
1.3.2 Tools 3
1.3.3 Result Settings 3
1.3.4 I/O and Communication 3
1.3.5 Environment 3
1.4 Ordering Information 3

Chapter 2 Installation 5

Chapter 3 Image Acquisition 9

3.1 Get Data 10
Figure 3.1 Selecting a Data Source 10
3.1.1 Data Source 10
Figure 3.2 “From Camera” Settings 11
3.2 Acquisition Mode 12
3.2.1 Single Frame Mode 12
Figure 3.3 Basic Hardware Setup for Image Capture 12
Figure 3.4 Single Mode Setting 13
3.2.2 Continuous Mode 13
3.2.3 Timer Trigger Mode 14
Figure 3.5 Timer Interval Setting 14
Figure 3.6 Display Page for Timer Trigger 14
3.2.4 ToE Trigger Mode 14
Figure 3.7 ToE Hardware Setup 15

Chapter 4 Calibration 21

Figure 4.1 Camera Calibration 22
4.1 Dot Grid 22
Figure 4.2 Camera Calibration with a Grid of Dots 23
4.2 Landmark 23
Figure 4.3 Adding Coordinates for Camera Calibration 23
Figure 4.4 Camera Calibration with Multiple Points 24

Chapter 5 IMP Tools 25

5.1 Inserting an IMP Tool 26
Figure 5.1 Image Processing Tool 26
5.2 Simulate 26
Figure 5.2 Simulation of Image Processing 27
5.3 Create an ROI 27
Figure 5.3 Selecting an ROI 28
5.4 Identification Tools 28
5.4.1 Bar Code 28
Figure 5.4 Example of a Bar Code 29

5.4.2 QR Code 30
Figure 5.5 Example of a QR Code 30
Table 5.1: QR Code Settings 30
5.4.3 Data Matrix Code 31
Figure 5.6 Example of a Data Matrix Code 31
Table 5.2: Data Matrix Code Settings 31
5.4.4 OCR 32
Figure 5.7 OCR Settings 32
Figure 5.8 Creating a New User-Defined Font 33
Figure 5.9 Creating a User-Defined Character 33
5.5 Pattern Match 34
Figure 5.10 Pattern Match Process 34
5.5.1 Learning Process 34
5.5.2 Matching Process 37

Chapter 6 Result Setting 41

6.1 Overview 42
6.2 IMP Output Parameters 42
6.3 Start Result Setting 43
Figure 6.1 Result Settings Index, Output, & Criteria Condition . 43
6.4 Limitation on Result Settings 44
6.5 Result Setting Demo 45

Chapter 7 Digital I/O and Communication 49

7.1 Digital Input 50
Figure 7.1 Digital Input Configuration Interface 50
Figure 7.2 Digital Input Debouncer Example 50
7.2 Digital Output 51
Figure 7.3 Digital Output Configuration Interface 51
Figure 7.4 Counter Mode Example 51
7.3 Communication Mode 51
7.3.1 TCP/IP 52
Figure 7.5 Setting up TCP-IP Communication 52
7.3.2 Serial Port Setting 55
7.3.3 Format String and Select Value 56

Chapter 8 Project Management 59

8.1 Project Operation 60
Figure 8.1 Project Management Toolbar 60
Figure 8.2 New Project 60
Figure 8.3 Load Project 60
8.2 Runtime Mode/Development Mode 60
Figure 8.4 Switching to Runtime Mode 61

Chapter 9 Use Case 63

9.1 Traceability in Data Matrix Code 64
9.2 Alignment 69

Chapter 1

Introduction

1.1 Description

Advantech EzBuilder is a configurable GUI-based machine vision software package that facilitates building and deploying machine vision applications without requiring the user to have any programming skills. It supports a wide range of Advantech industrial PCs, smart cameras, and embedded systems, and can be deployed on different hardware platforms without modification.

As a configurable cross-platform tool, it shortens the learning curve. With its user-friendly, flowchart-based design, EzBuilder provides an easy approach to system installation and project development while reducing future maintenance costs. Customers can complete their tasks easily by following three simple steps: 1) select an image, 2) process the image, and 3) output the results.

EzBuilder provides various GUI layouts to suit customer-specific applications. It is also designed to be task-oriented, meaning that users can quickly find the function they need to use. Furthermore, it is modular and offers flexible licensing options, making it the most cost-effective choice for customers seeking machine vision software solutions.

With its powerful yet easy-to-use identification, alignment, inspection, and gauging tools, EzBuilder is suitable for a wide range of automated inspection applications aimed at tracking/tracing, present/absent decision-making, guidance, material handling, and quality assurance.

1.2 Features

- Intuitive GUI that does not require programming skills
- Complies with the GenICam standard, supports GigE Vision 2.0-compliant cameras
- Flexible licensing options, including identification, alignment, inspection, and gauging modules to reduce total cost of ownership
- Supports up to four GigE Vision cameras
- Thread-safe and multitasking vision inspection

1.3 Specifications

1.3.1 Image Acquisition

Compatibility	GigE Vision 2.0
No. of cameras	up to 4
Type	Camera, image file input
Mode	Software, hardware trigger
Resolution	up to 10 MP (3856 x 2764)
Color format	Mono, Bayer pattern

1.3.2 Tools

Calibration	Dot grid, multiple points
Identification	1D bar code, data matrix code, QR code, OCR
Alignment	Pattern matching, advanced pattern matching

1.3.3 Result Settings

Operator	AND, OR, NOT, XOR, addition, subtraction, multiplication, division
Data format	String, numeric

1.3.4 I/O and Communication

Protocol	TCP/IP, RS-232
Digital I/O	Trigger input, digital output, lighting control

1.3.5 Environment

O.S	Windows 7, 10 (32/64-bit)
Language	English
Hardware	VPS-3100, PCIE-1172-AE, PCIE-1174-AE
Display	800x600 or above

1.4 Ordering Information

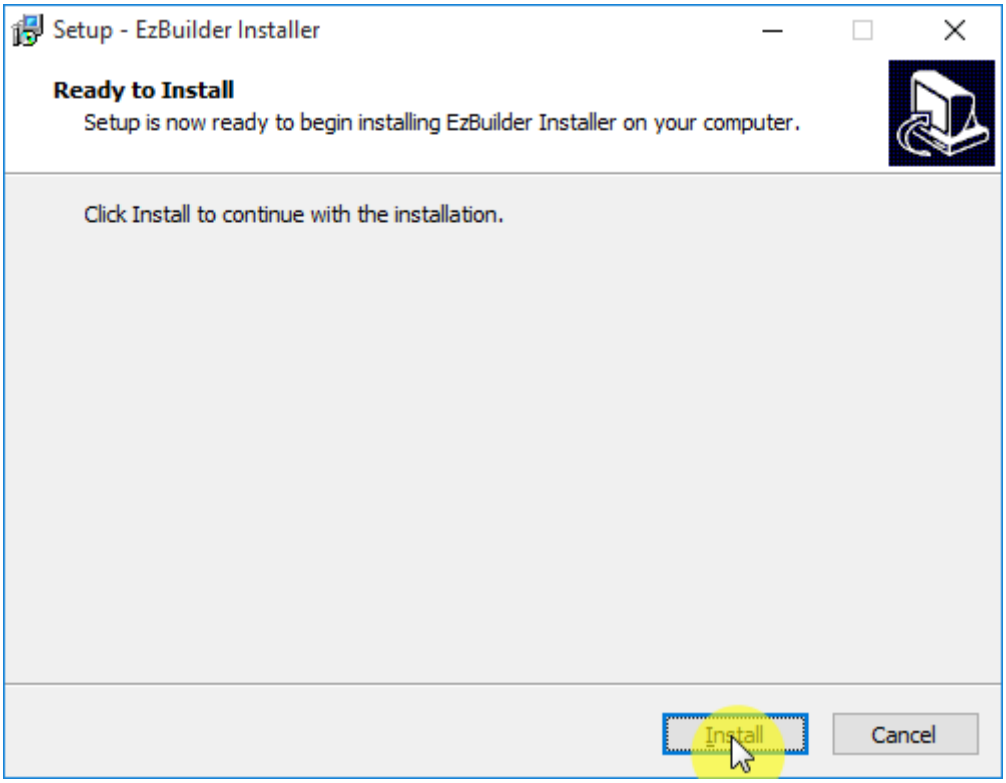
- EZB-EEV-10ID: EzBuilder Identification Software
- EZB-EEV-10AL: EzBuilder Alignment Software
- EZB-EEV-10FU: EzBuilder Full Functions Software

Chapter 2

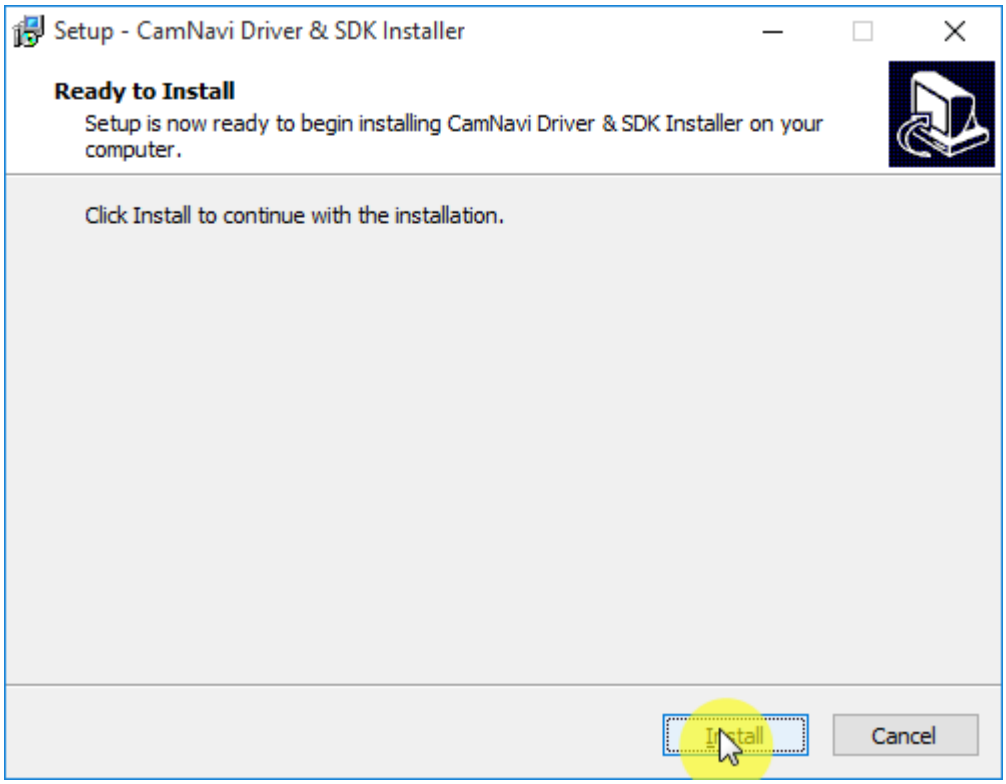
Installation

Execute **EZBUILDER_FULL_INSTALLER_v1.0.0.4.exe** to start up the installation. Please refer to the operation instructions below and follow them step by step:

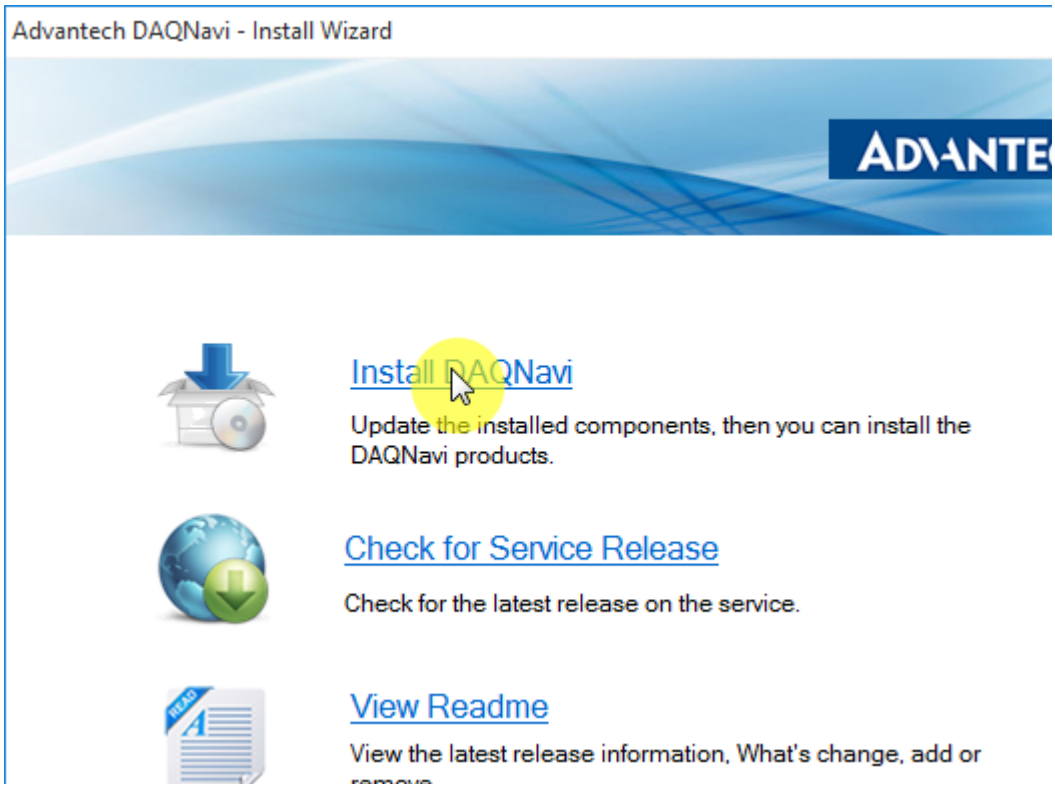
1. Install Ezbuilder



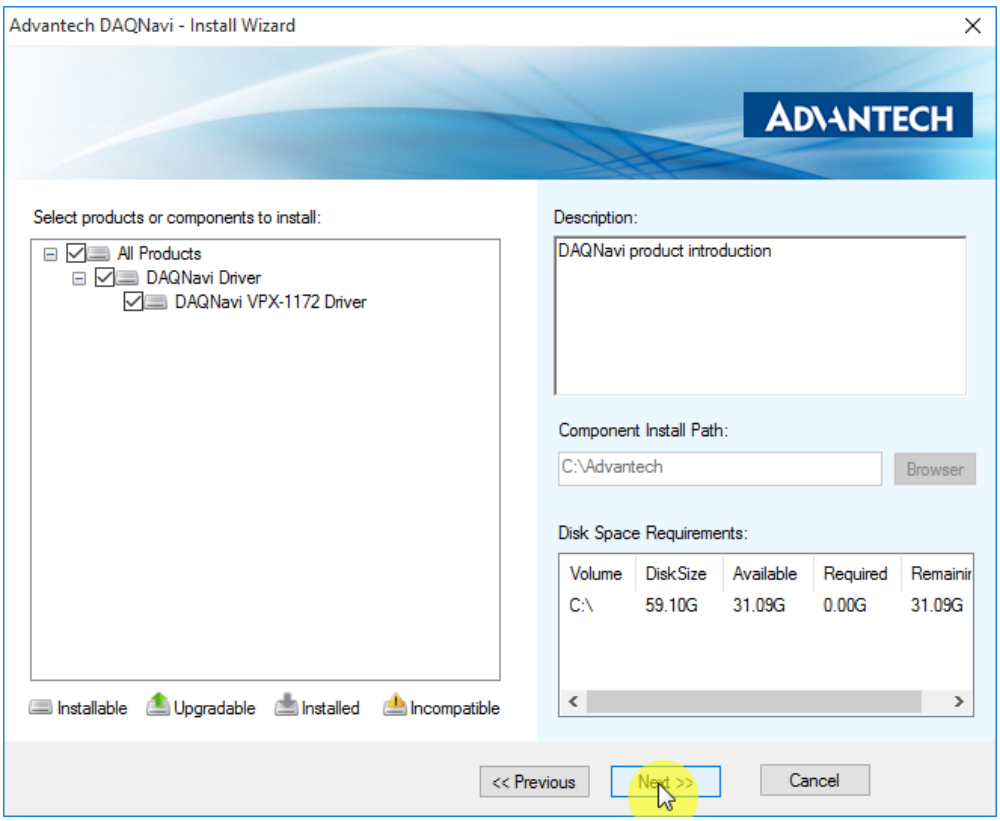
2. Install CanNavi Driver & SDK



3. Install DAQNavi



4. Select the VPX-1172 driver and click **Next**



Chapter 3

Image Acquisition

3.1 Get Data

Images can be loaded from a file, folder, or GigE Vision camera. When the image has loaded onto the display area, you can zoom in/out by scrolling the mouse wheel and pan by pressing the middle mouse button.

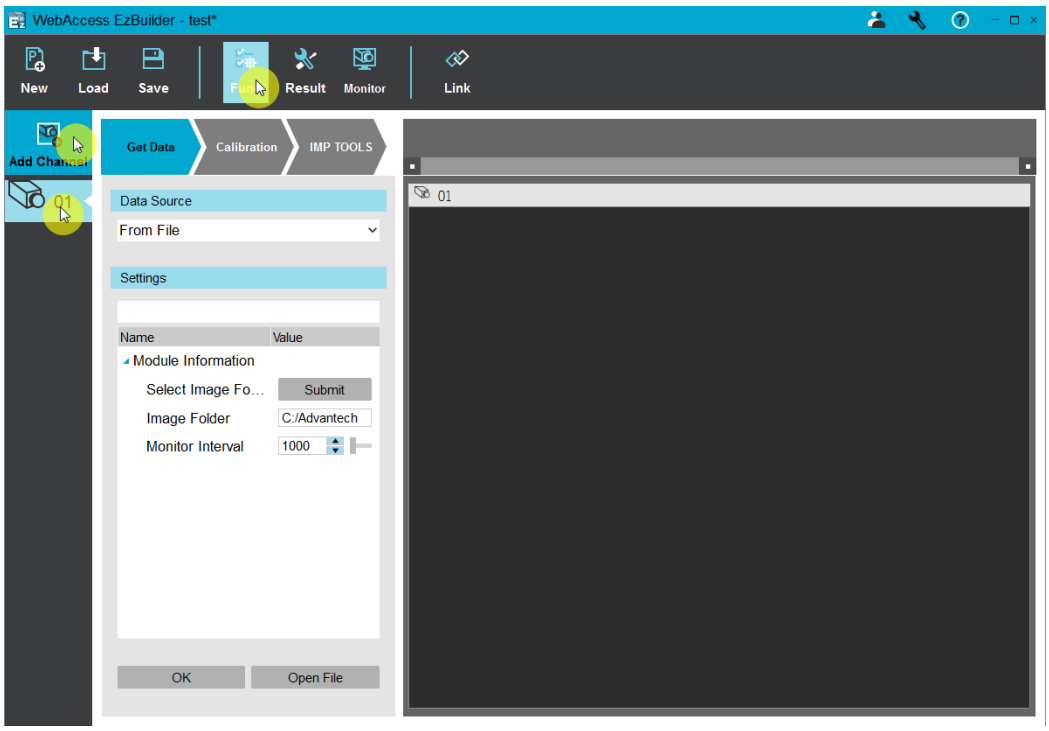


Figure 3.1 Selecting a Data Source

3.1.1 Data Source

From File

Click **Open File** to select a BMP or TIFF image file. The selected image will be shown in the display area of the right panel.

When you finish configuring the settings, click **OK** to proceed to the next step.

"From File" Data Source Settings:

Select Image Folder	Select a folder to load all supported images for a slide show in monitor or user mode
Monitor interval	The duration (ms) between images

From Camera

Use **Select Camera** to select a camera as the data source.

Click **Start** to perform image acquisition from the selected camera.

Click **Stop** to stop image acquisition from the selected camera.

Click **Get Standard Image** to snapshot an image from the selected camera.

The acquired image will be shown in the display area of the right panel.

This acquired image is needed for the "IMP tools" step.

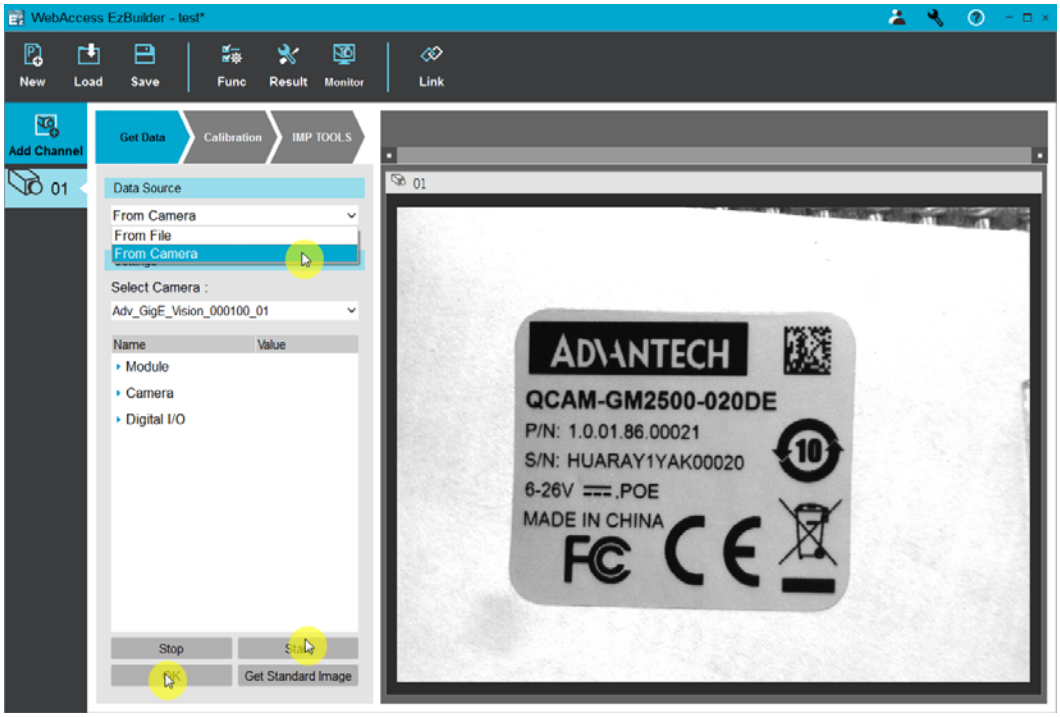


Figure 3.2 "From Camera" Settings

Note! *While the selected camera is performing image acquisition, image acquisition will stop and an image will be captured when you leave the* ***Get Data*** *panel or click* ***Stop****.*

"From Camera" Data Source Settings

Module	This includes settings that show information and basic operation for the selected camera.
Camera	The settings of the selected camera. Depending on cameras, the settings are different.
Digital I/O	The settings of PCIE frame grabber.

After the get data settings have been completed, click **OK** to proceed to the next step.

Note! *EzBuilder will memorize the channel you added on the project and shows on the channel list in monitor function after you click* ***OK*** *on the* ***Get Data*** *panel.*

3.2 Acquisition Mode

Ezbuilder supports four modes for image acquisition: 1) single frame mode, 2) continuous mode, 3) timer trigger mode, and 4) trigger-over-Ethernet (ToE) mode.

3.2.1 Single Frame Mode

Single frame mode is also known as camera snapshot. You can capture an image by pressing **Get Standard Image**. The image will be stored as a BMP file in the default directory and will also be displayed on the screen in real time.

Hardware setup

Figure 3.3 shows the installation configuration for basic image capture, such as that used for single mode, continuous mode, and timer trigger mode.

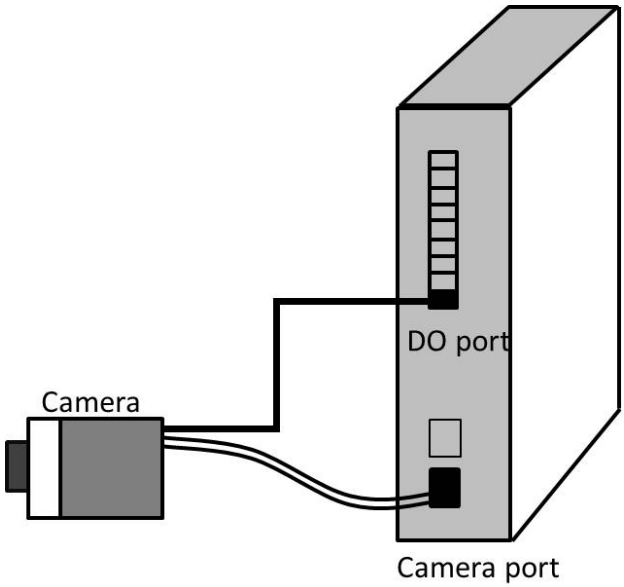


Figure 3.3 Basic Hardware Setup for Image Capture

EzBuilder Settings

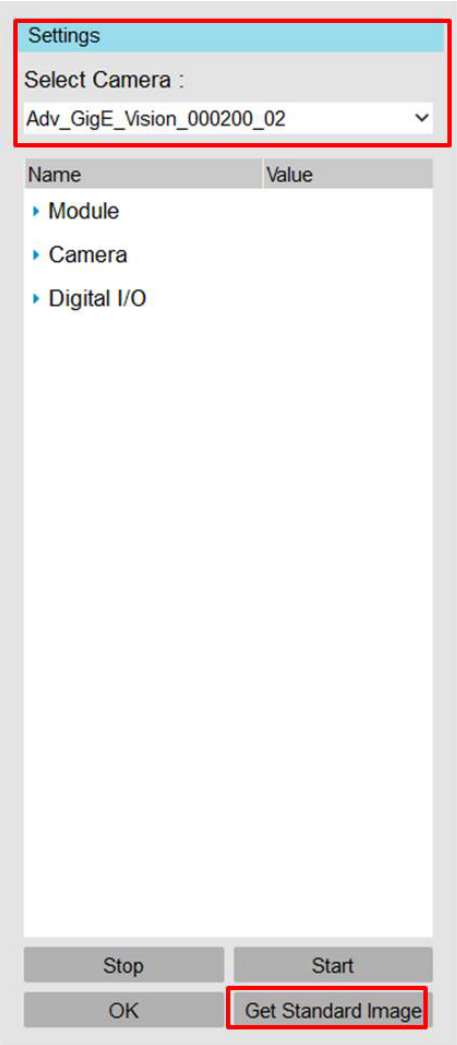


Figure 3.4 Single Mode Setting

The **Get Data** panel provides an interface for the different acquisition modes. Once you have successfully installed your hardware, the image acquisition source can be selected from the **Data Source** field and the camera can be selected from the **Select Camera** field. Single mode image capture can be implemented when **From Camera** is selected as the data source and **Adv_GigE Camer**a is selected as the camera source. You can manually capture an image by pressing **Get Standard Image**.

3.2.2 Continuous Mode

Continuous mode sends a stream of image data to your PC. Real-time images will thus be displayed via EzBuilder, and you can use this mode to adjust the camera and optical setting (e.g., position, aperture, focus).

Hardware Setup

Please refer to Figure 3.3.

EzBuilder Settings

The configuration procedure is the same as single mode except for the final step. Here, you need to press **Start** to trigger continuous mode.

3.2.3 Timer Trigger Mode

Timer trigger mode can trigger the camera to capture an image snapshot periodically.

Hardware Setup

Please refer to Figure 3.3.

EzBuilder Setting

The procedure to set up periodical capture has the same first two steps as single capture mode, but there are some additional settings that need to be implemented.

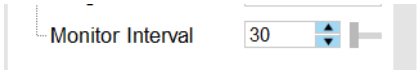


Figure 3.5 Timer Interval Setting

You need to give a value in milliseconds for the monitor interval. In the example shown in Figure 3.5, the value is 30 ms, which is the lowest time interval supported by EzBuilder.

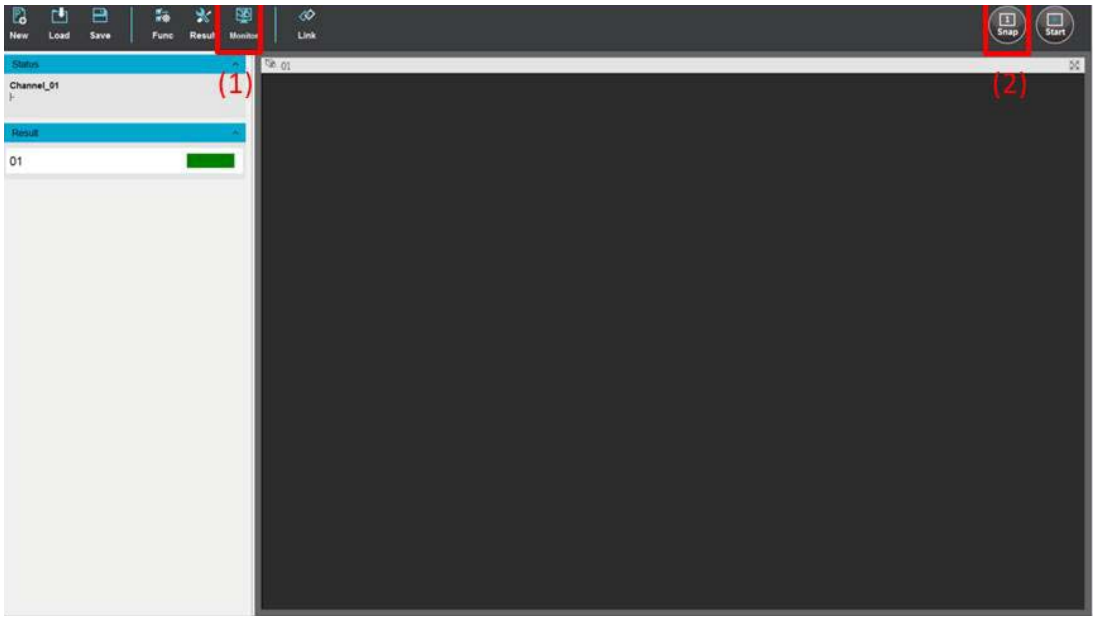


Figure 3.6 Display Page for Timer Trigger

The displayed images are not shown on the same page as where the settings are configured. Press **Monitor** on the toolbar to jump to the display page, which is shown in Figure 3.6. You can start to capture images periodically by pressing **Start**.

3.2.4 ToE Trigger Mode

Ezbuilder provides ToE trigger mode to guarantee real-time operation. ToE mode is available for the VPS-3100 and PCIE-1172/1174. The trigger is from an external signal connected to the VPS-3100 or PCIE-1172/1174.

Hardware Setup

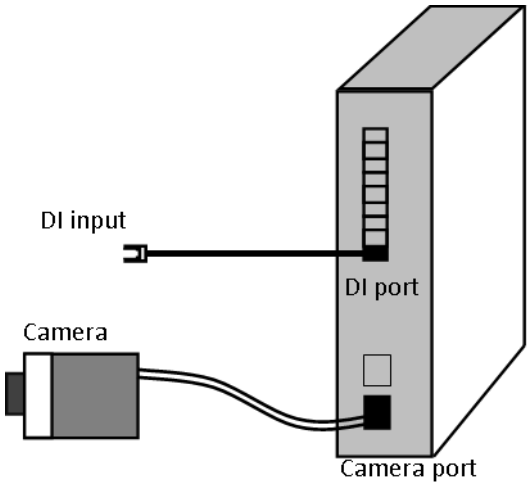


Figure 3.7 ToE Hardware Setup

The only difference between ToE hardware setup and normal hardware setup is that there is an additional wire connection between the digital input port on the VPS-3100 and the other end terminal of the signal generator.

The digital input wire is for sending a digital signal to trigger the camera to capture an image. This method resolves the real-time problem when the system is operating in a time-deterministic environment

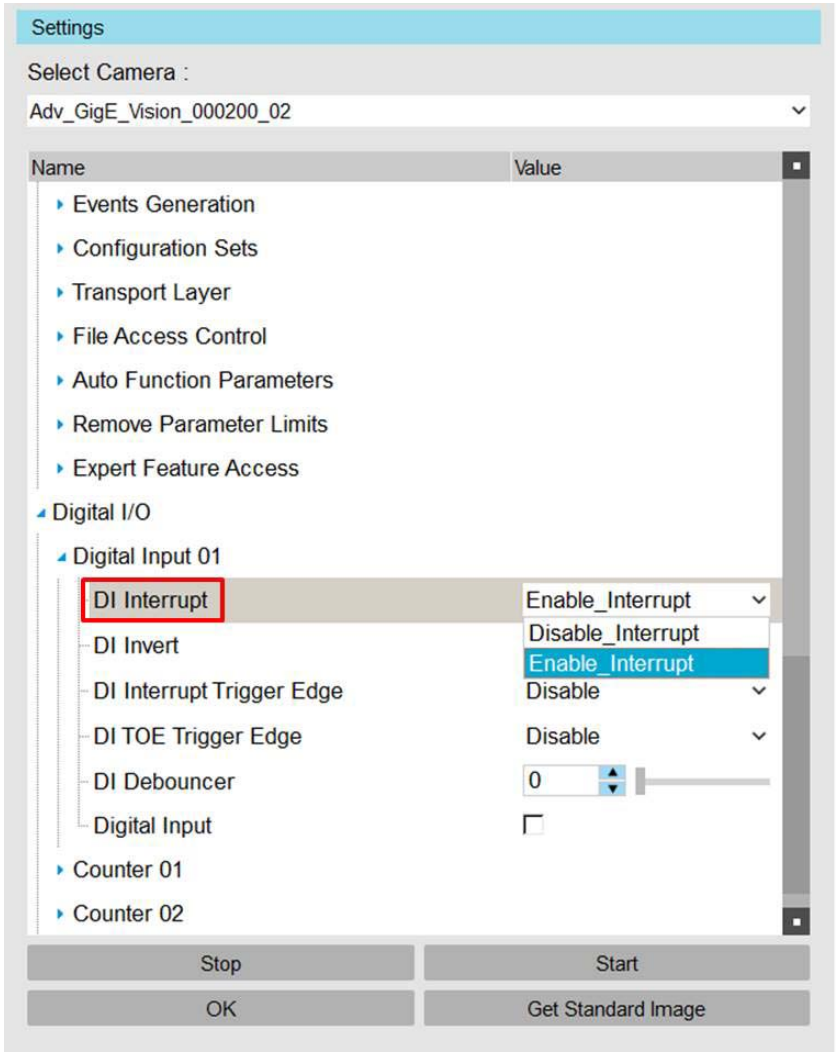
.

EzBuilder Settings

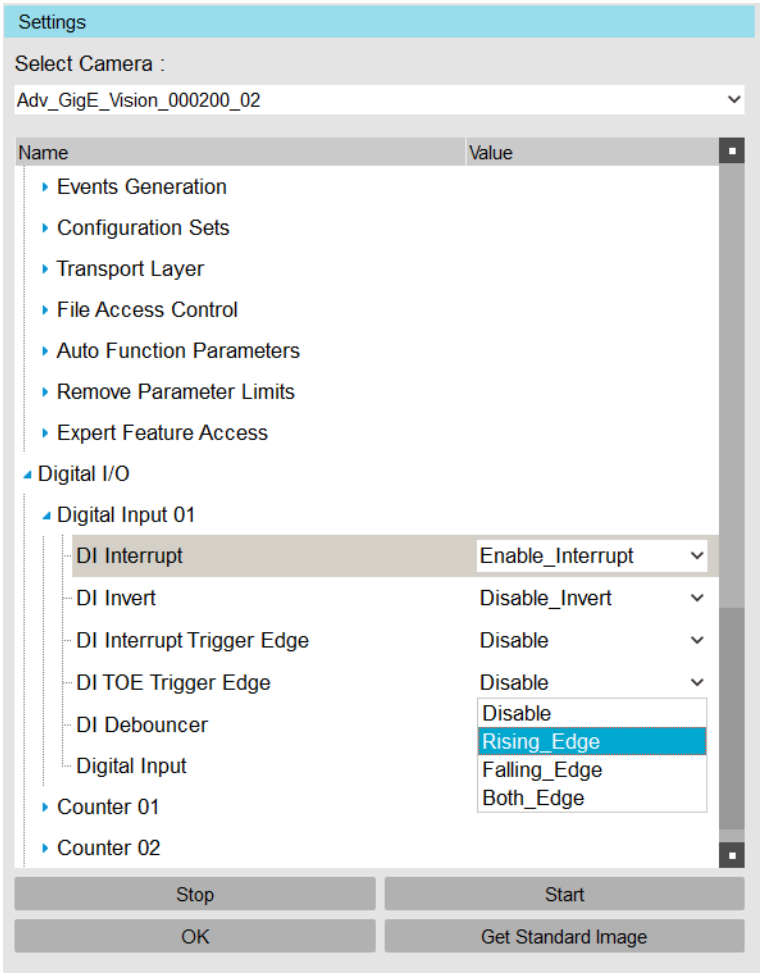
The hardware setup described in the previous section is only part of the necessary conditions for implementing the ToE function. You will also need to configure specific items in Ezbuilder to implement this function, as detailed in the following steps.

There are only Basler, JAI and Advantech industrial camera support the ToE function currently. Please be sure your camera has ToE function before you implement the ToE trigger mode with Ezbuilder.

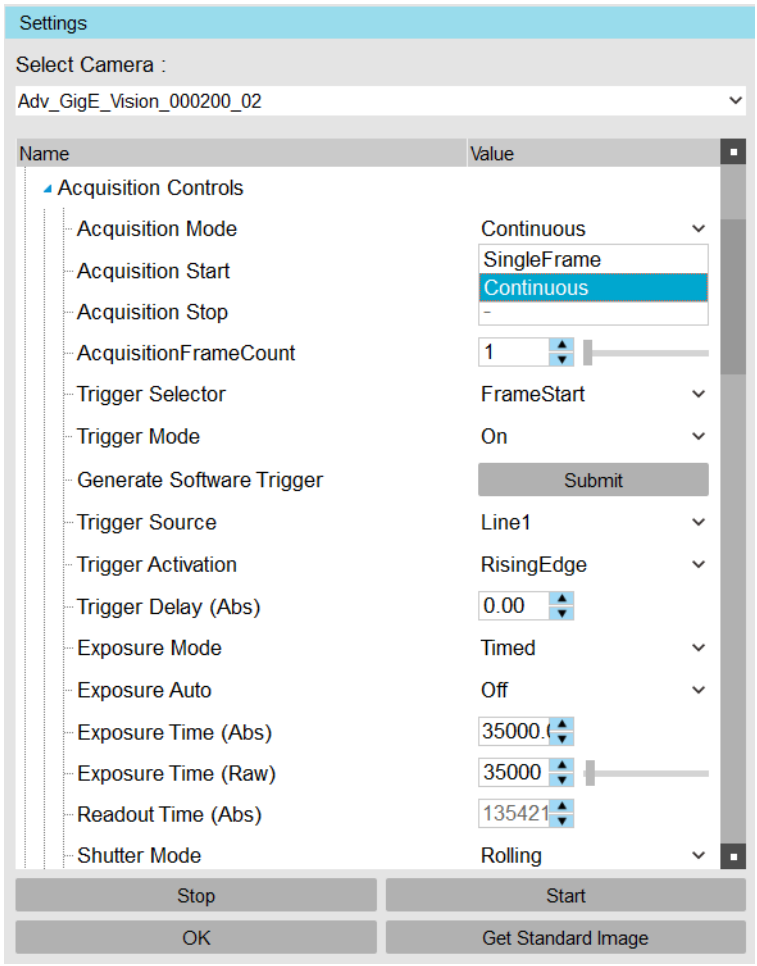
1. In the **DI Interrupt** field under **Digital I/O**, select **Enable_Interrupt**



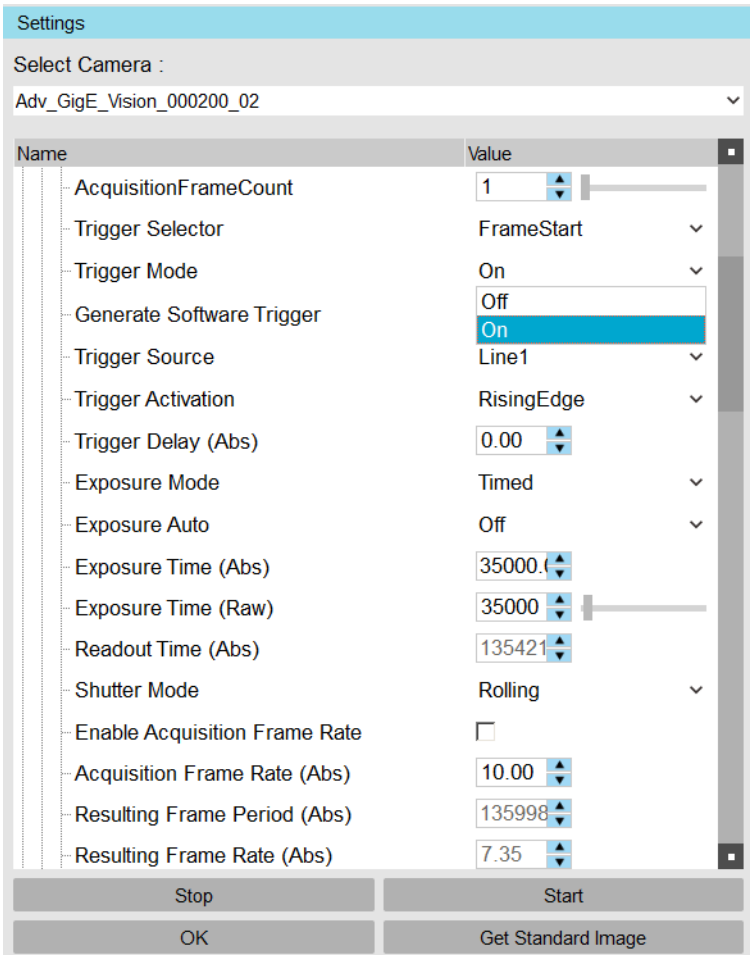
2. In the **DI TOE Trigger Edge** field under **Digital I/O**, select the type of trigger mode: **Rising_Edge**, **Falling_Edge**, or **Both_Edge**. After ToE trigger mode has been enabled, there are three options that can be selected: **Rising_Edge**, **Falling_Edge**, and **Both_Edge**.



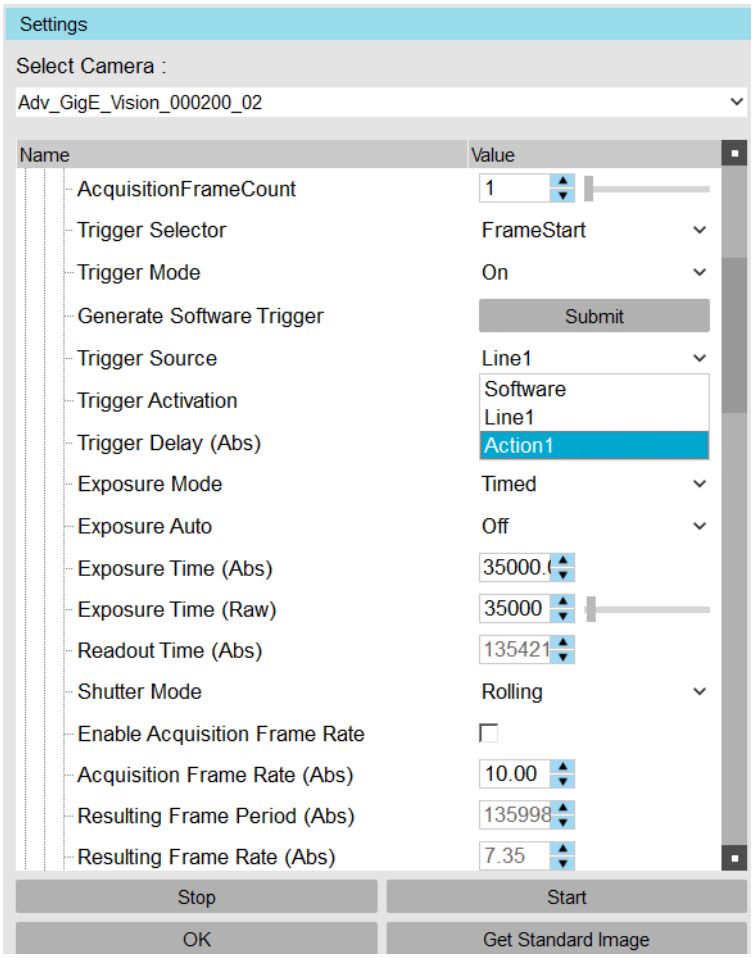
3. In the **Acquisition Mode** field under **Acquisition Controls**, select **Continuous**.



4. In the **Trigger Mode** field under **Acquisition Controls**, select **On**.



5. In the **Trigger Source** field under **Acquisition Controls**, select **Action1**.



Chapter 4

Calibration

The calibration methods and the corresponding settings for calibration are in the left panel. The right panel is the image area for a loaded image from a file or a live image from a camera as the calibration target.

Click **Get Image** on the **Calibration** panel. If the data source under the **Get Data** panel is set to **From File**, then an **Open Image** dialog box will appear for you to select an image as the calibration target.

Otherwise, it will grab an image from the camera as the calibration target.

There are two calibration methods: 1) dot grid and 2) landmark.

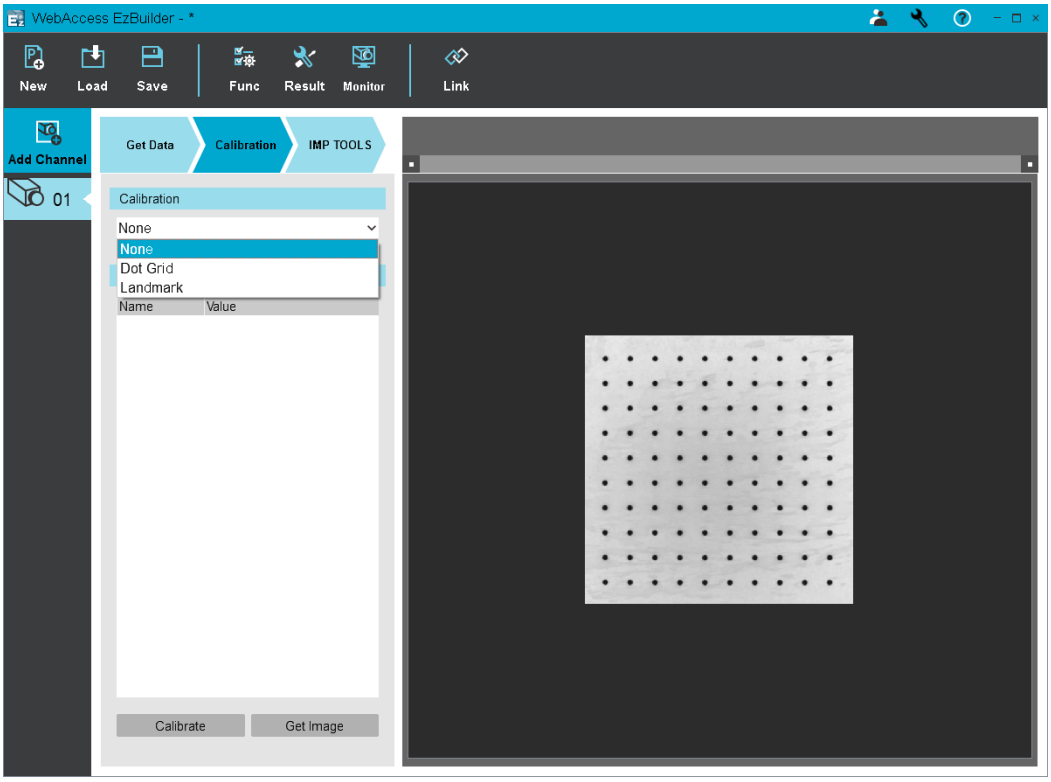


Figure 4.1 Camera Calibration

4.1 Dot Grid

After the settings have been completed, click **Calibrate** and a confirmation dialog box will appear when the process is successful and a .cal file will be generated at the following path:

C:\Advantech\EzBuilder\calibration\channelxx_Dotgrid.CAL

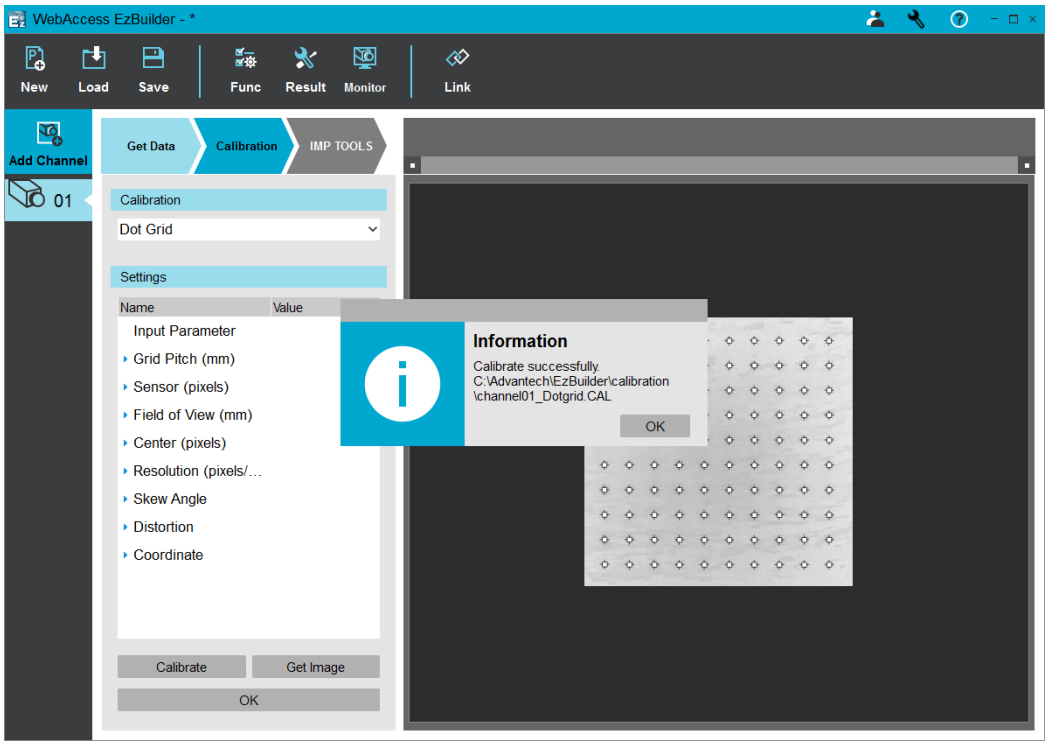


Figure 4.2 Camera Calibration with a Grid of Dots

4.2 Landmark

You must set up at least four reference points to a calibration function.

Right-click on the image to show the context menu and select **Add Landmark**.

You can then insert a reference point by left-clicking on the image and dragging the point to the desired position. You can also directly click **Add Landmark** under **Settings** on the **Calibration** panel. Clicking the point will open the **Update** dialog box.

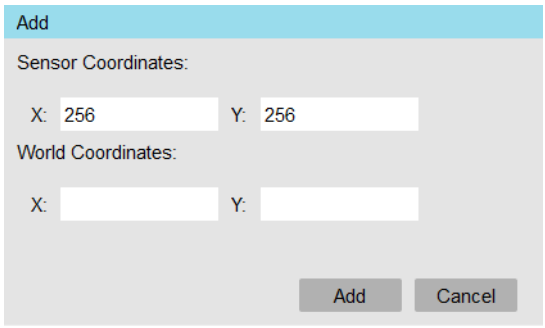


Figure 4.3 Adding Coordinates for Camera Calibration

After you have set up at least four reference points, click **Calibrate** on the **Calibration** panel and a confirmation dialog box will appear when the process is successful. A .cal file will be generated at the following path:

C:\Advantech\EzBuilder\calibration\channelxx_Landmark.CAL

.

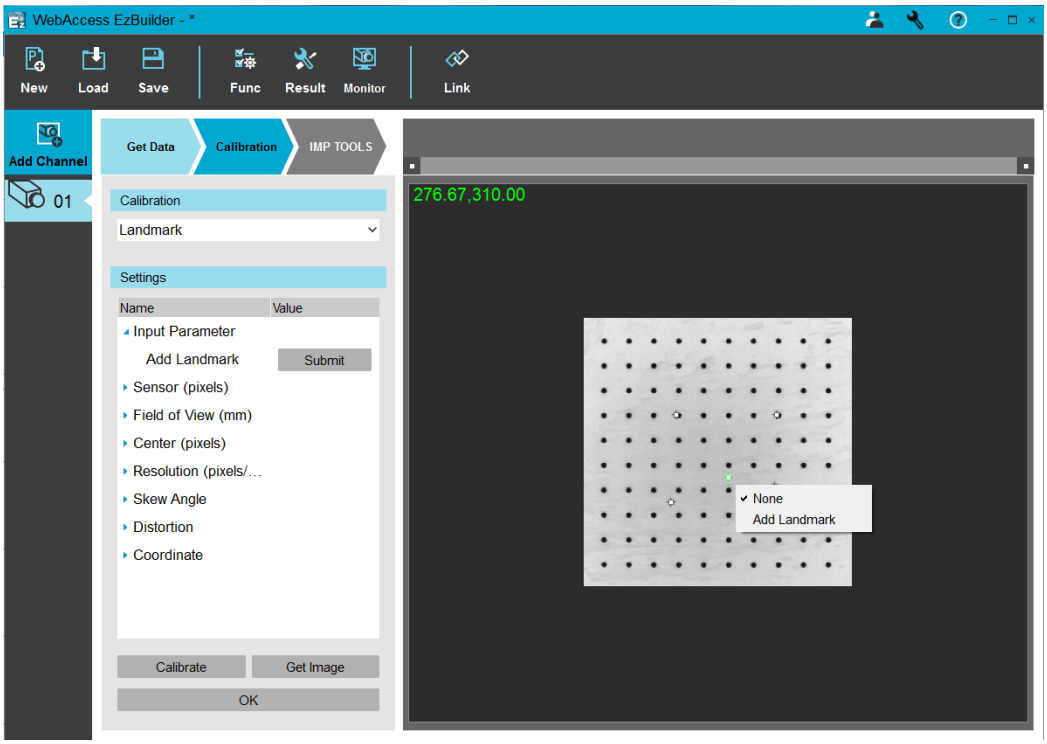


Figure 4.4 Camera Calibration with Multiple Points

These generated .cal files are ready for pattern match.
Click **OK** to proceed to the next step.

Note! *The calibration step is not necessary. You can skip this step by clicking **OK**.*

Chapter 5

IMP Tools

The **IMP TOOLS** toolbar is located at the top of right panel.

5.1 Inserting an IMP Tool

Click the **Add** icon ⊕ to open the IMP TOOLS dialog box. Choose the desired tool from the dialog box to insert an IMP TOOL tab in the toolbar. The corresponding settings will be shown in the left panel.

The title of the tab will be used as an IMP variable name under **Result** in the **IMP TOOLS** panel. You may insert up to four tools for a channel.

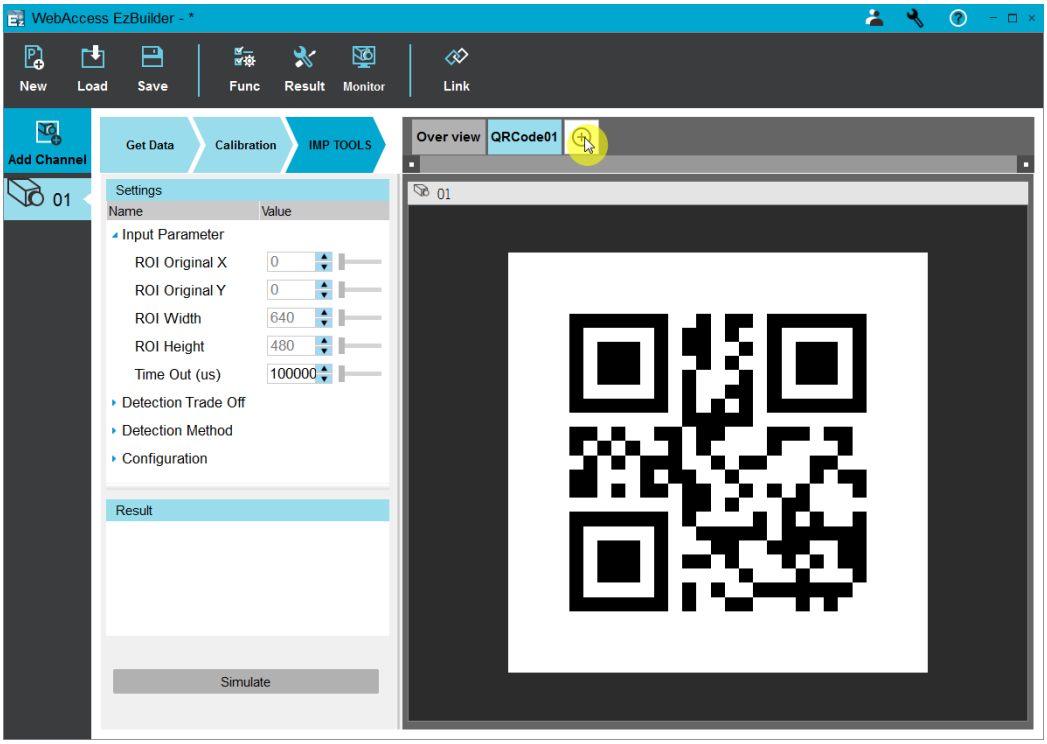


Figure 5.1 Image Processing Tool

5.2 Simulate

Click **Simulate** to apply the IMP tools to the image.

The returned result will be shown on the image. Detected text will be shown in the top left corner and the processing time of each tool will be shown in the bottom right corner. If the desired object cannot be detected, "NG" will appear in red in the top left corner.

Figure 5.2 Simulation of Image Processing

Right-click the image to show a context menu and select **Save as** to save the image. EzBuilder supports Bmp, Tiff, and Jpeg image formats. You can select the specific tool tab and click **Simulate** in the **IMP TOOLS** panel to check the result of the selected tool. Alternatively, you may select the **Overview** tab and click **Simulate** to check the results of all tools on the channel.

5.3 Create an ROI

Right-click the image in the right panel to show the context menu and select **New ROI** to create an ROI. You can move the ROI to the required position by dragging the ROI corner and side handles. Alternatively, you can adjust the parameters under **Input Parameter** in the **IMP TOOLS** panel (i.e., ROI Original X, ROI Original Y, ROI Width, and ROI Height). Right-click on the image again to show the context menu and select **Set ROI**. Each tool can have no more than one ROI, which can be modified or removed via the context menu.

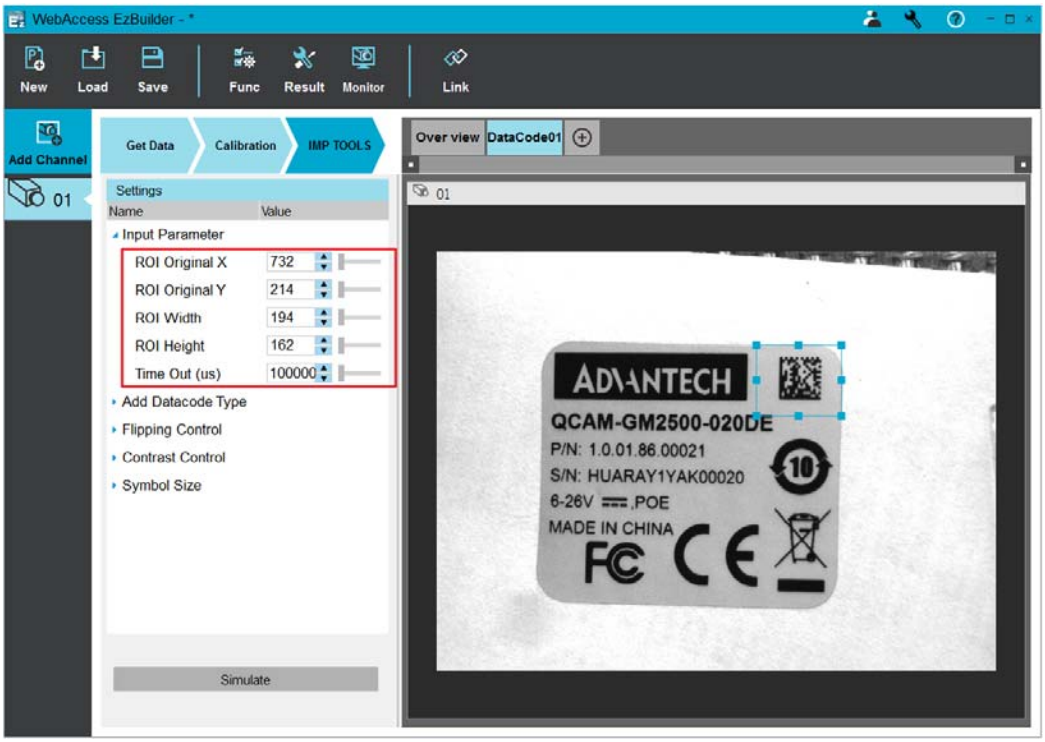


Figure 5.3 Selecting an ROI

5.4 Identification Tools

5.4.1 Bar Code

Symbology

A bar code is a 2D pattern of parallel bars and spaces of varying thickness that represents a character string. It is arranged according to an encoding convention (symbology) that specifies the character set and encoding rules.

- The bar code may be black ink on a white background or inverted (white ink on a black background)
- The bar code should be preceded and followed by a quiet zone of at least ten times the module width (smallest bar or space thickness)
- Bars should be surrounded below and above by a quiet zone of a few pixels
- Bar and space widths must be greater than or equal to 2 pixels

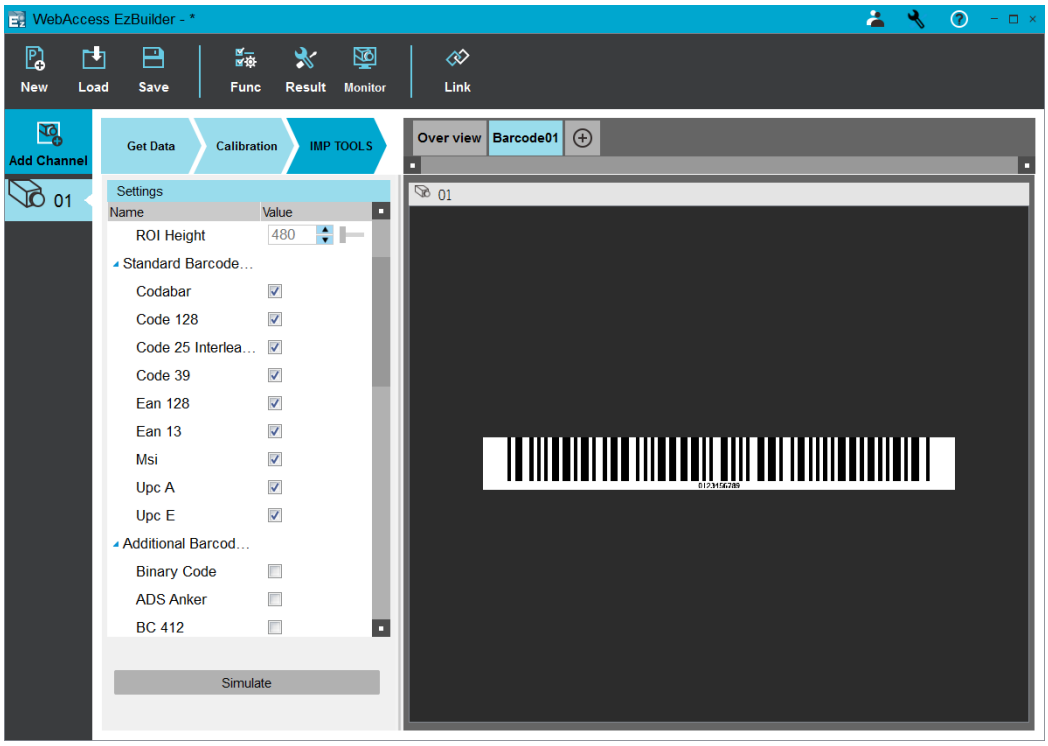


Figure 5.4 Example of a Bar Code

Standard Symbologies Supported by Ezbuilder:

Codabar	Code 39	Msi
Code 128	Ean 128	Upc A
Code 25 Interleaved	Ean 13	Upc E

Additional Symbologies Supported by EzBuilder:

Binary CodeADS Anker	Code 2/5 Inverted	EAN 8
BC 412	Code 32	IBM Delta Distance A
Code 11	Code 39 Extended	Plessey
Code 13	Code 39 Reduced	Telepen
Code 2/5 Datalogic	Code 93	Rss 14
Code 2/5 Matrix	Code 93 Extended	Rss 14 Limited
Code 2/5 IATA	Code BCD Matrix	Rss 14 Expaned
Code 2/5 Industry	Code C.I.P	
Code 2/5 Compressed	CodeSTK	

Checksum

A checksum character enables the reader to check the barcode validity depending on the symbology:

- The checksum may be mandatory and must be checked by the reader
- The checksum may be mandatory but may not need to be checked
- The checksum and its verification may both be optional

5.4.2 QR Code

A QR code is a matrix barcode comprising black squares on a white background. One dot (or "module") represents one bit of information. QR codes contain various types of data, such as different models, versions, and levels. They always contain a message, metadata about the alignment, size, format, and error correction bits.

They comply with the international standard ISO/IEC 18004 (1, 2, and 2005).

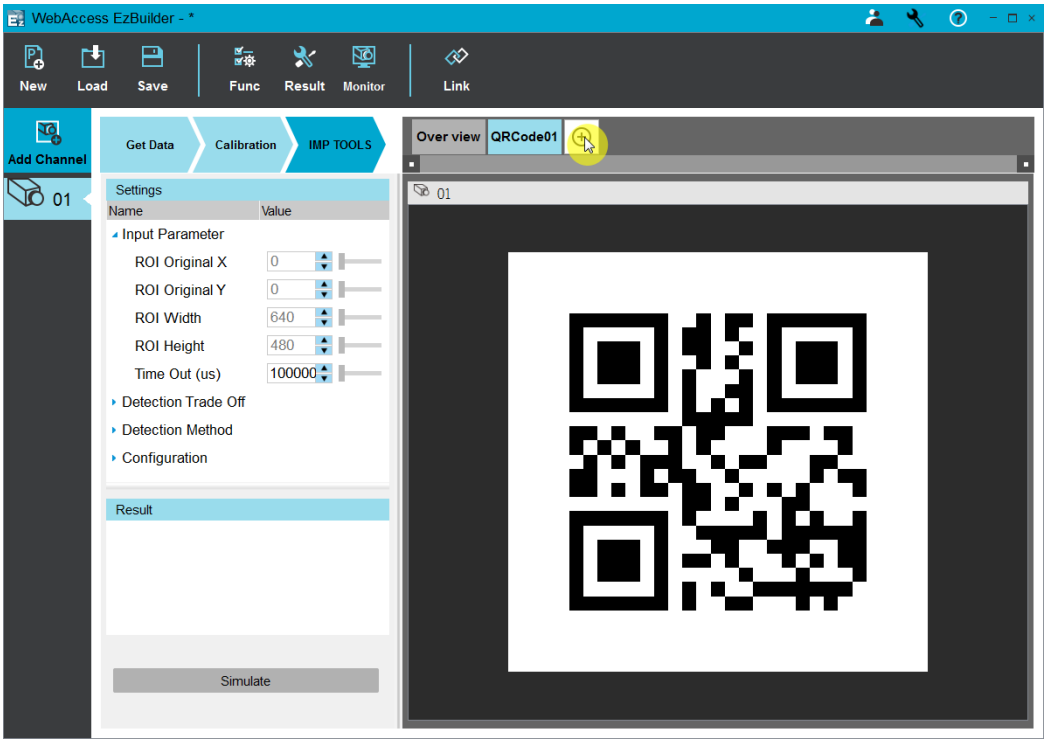


Figure 5.5 Example of a QR Code

Table 5.1: QR Code Settings	
Detection Trade-Off	Controls the trade-off between computation speed and reliability with regard to the detection methods
Detection Method	Sets the detection method for finding QR codes
Minimum Version	Minimum version of QR codes to be searched for
Maximum Version	Maximum version of QR codes to be searched for
Minimum Isotropy	QR code minimum isotropy
Minimum Score	Minimum pattern-finder score that must be reached to consider a finder pattern as having been found
Cell Confidence Threshold	Sets the minimum cell polarity confidence threshold; when the cell confidence is under the threshold, additional processing is attempted to improve the polarity detection
Perspective Mode	Sets the perspective mode
Scan Precision	Precision of the QR code reader when scanning the search field
Foreground threshold	Determines how many grayscale-values a pixel should deviate from its local background to be considered part of the foreground

5.4.3 Data Matrix Code

In a single read operation of data matrix code, EzBuilder locates, unscrambles, decodes, reads, and grades the quality of grayscale 2D data matrix codes of any size, contrast, location, and orientation (even those viewed from the back on a transparent medium), provided that they meet these specifications:

- Minimum quiet zone (blank zone around the matrix code) width: 3 pixels
- Minimum cell (= module) size: 3 x 3 pixels
- Maximum stretching (ratio between cell width and height): 2

A data matrix code can be read even when damaged, using a built-in error correction system.

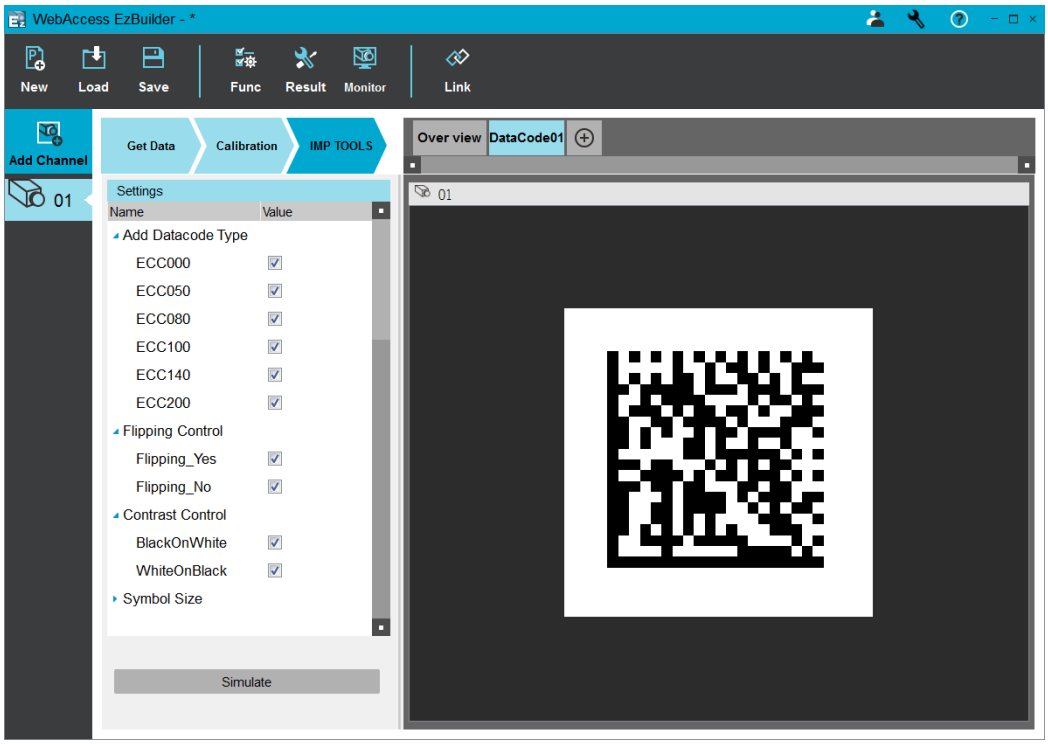


Figure 5.6 Example of a Data Matrix Code

Supported Data Matrix Code Types

ECC000	ECC080	ECC140
ECC050	ECC100	ECC200

Table 5.2: Data Matrix Code Settings	
Flipping Control	Values for the flipping of an image
BlackOnWhite	Dark cells on a light background
WhiteOnBlack	Light cells on a dark background
Symbol Size	Symbol logical size of S1 x S2

5.4.4 OCR

OCR reads short texts (such as serial numbers, part numbers, and dates). It uses font files (pre-defined OCR-A, OCR-B, and semi-standard fonts, or other learned fonts) with a template matching algorithm that can recognize even badly printed, broken, or connected characters of any size. There are four steps to recognizing characters:

1. Raw image capture
2. Object segmentation
3. Character isolation
4. Character recognition

OCR Settings

The default font is OCR-A. You can select other pre-defined fonts from the **Select Font** list. If you select **Font File**, the font listed in the **Font File** field will be used as the desired font. Click **Load Font** to load the font from file system and the file in the **Font File** field will be automatically selected in the **Select Font** list.

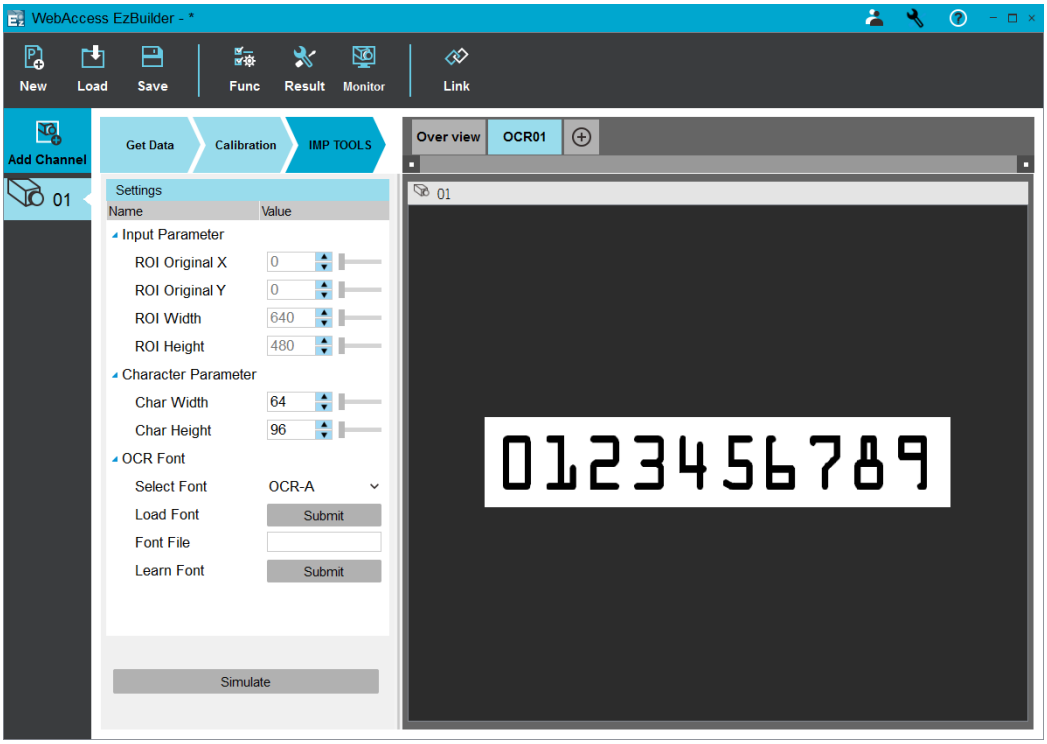


Figure 5.7 OCR Settings

Create a New Font

Click **Learn Font** under **OCR Font** in the **IMP TOOLS** panel. This will open the **OCR Font** dialog box, which lets you create a new font or modify an existing one.

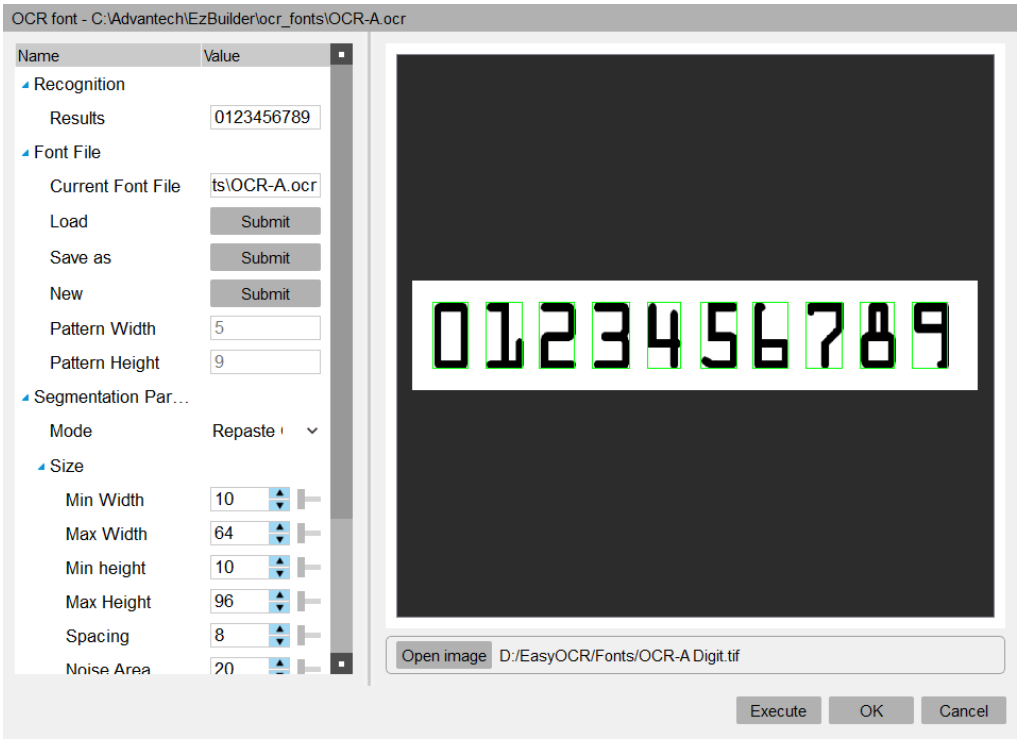


Figure 5.8 Creating a New User-Defined Font

The steps for creating a new font are as follows:

1. Open the **OCR Font** dialog
2. Click **Open Image** to open the target image
3. Click **New** and the click **OK** in the confirmation dialog box
4. In the **New OCR Font** dialog box, enter the desired pattern width and height values. Enter the text that is your expected result in the text field. If the number of the blobs is equal to the number of entered characters, then the learning patterns will be built, the color of the blob bounding boxes will be green; otherwise, the color will be blue.
5. If the learning patterns are not built, click each blue bounding box and enter the character code to build the pattern in the **Character** dialog box

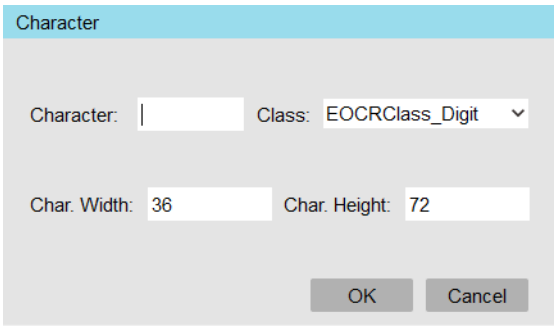


Figure 5.9 Creating a User-Defined Character

6. If all patterns are built, click "Execute" button. The result will be showed in the "Recognition" setting.

5.5 Pattern Match

The matching tool in EzBuilder is a gray-level and color-pattern matching library. This means that the target image format can be grayscale (Mono8) or color (RGB). The library is pixel-value-based. It compares the pixels of the pattern to the pixels of the sample image. Every pixel is weighed equally, giving no preference to any specific part of the pattern. You may train the system on a reference pattern and subsequently locate its occurrences in other images. This tool is quite convenient when the position of a given part in the field of view is unknown or if the presence of parts must be controlled. The concept is illustrated in the following figure:

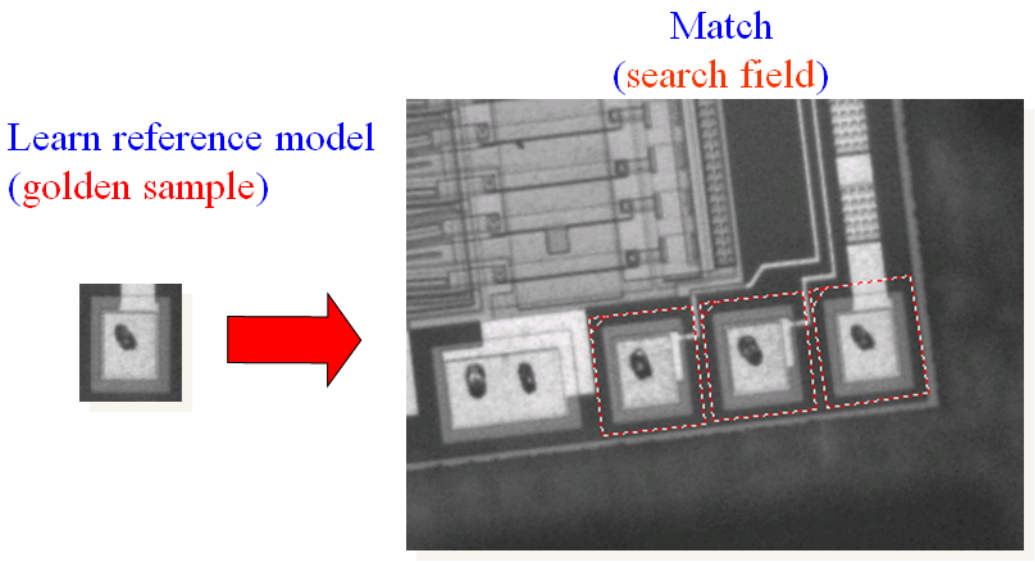
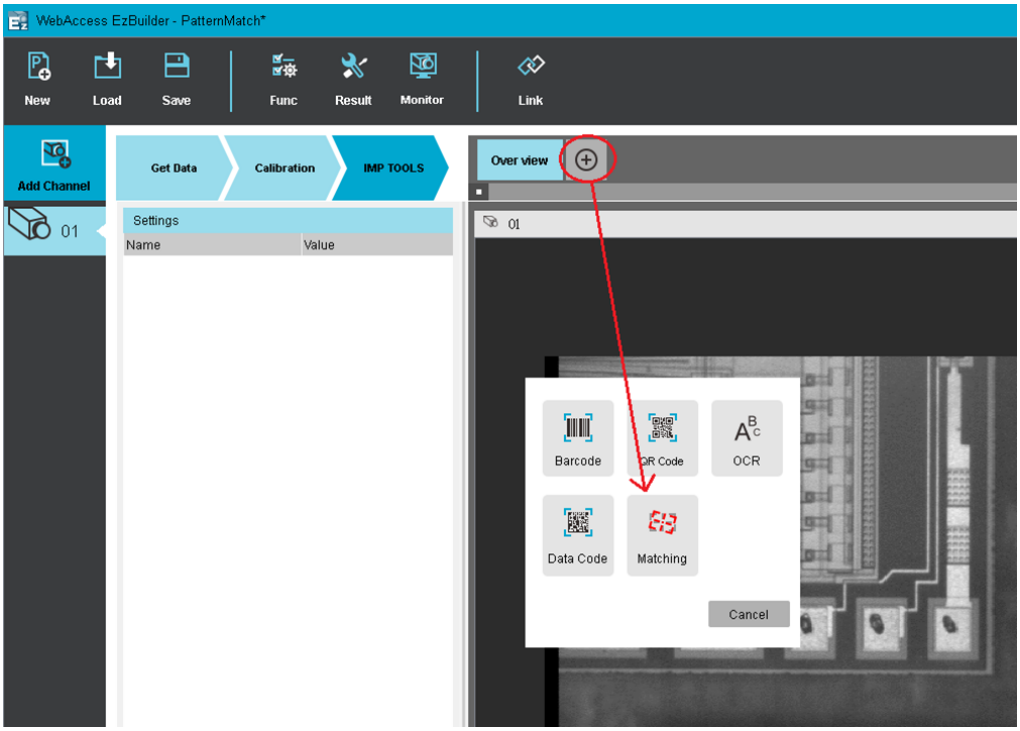


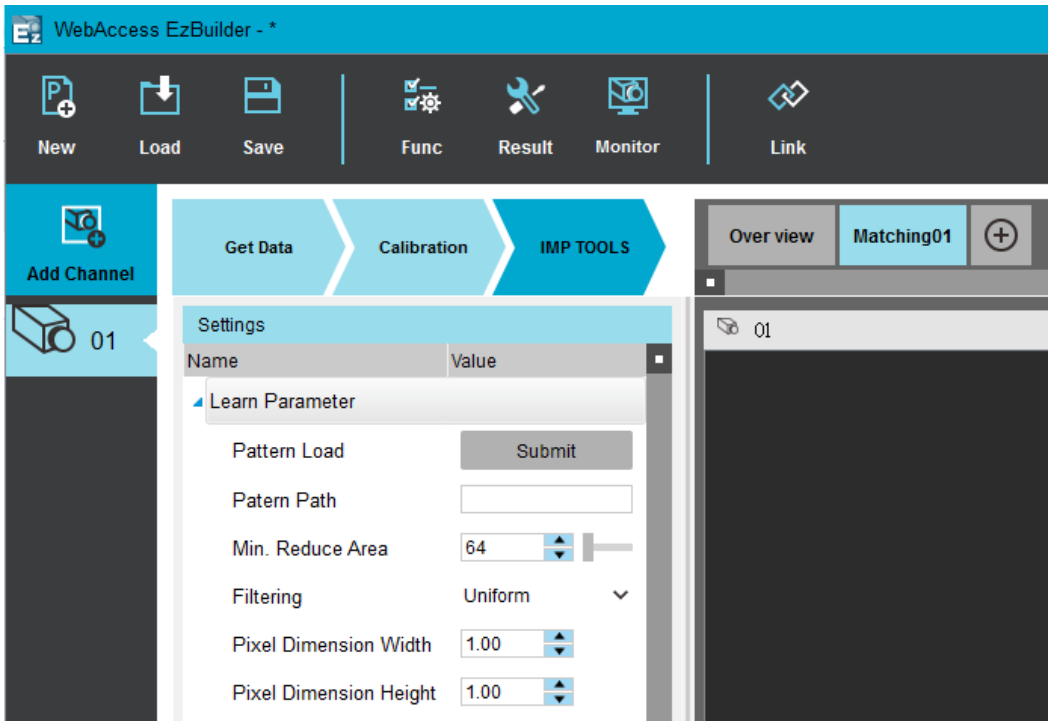
Figure 5.10 Pattern Match Process

5.5.1 Learning Process

1. Open EzBuilder and add the **Matching** tool tab to the toolbar

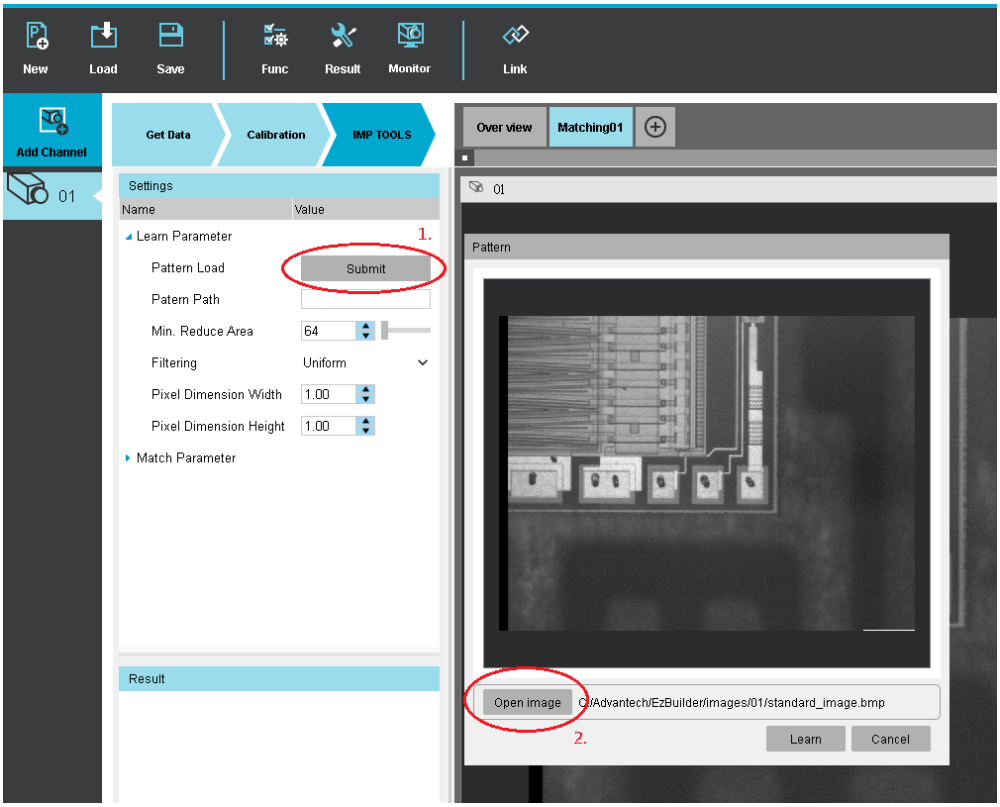


2. Tune the relevant learning parameters before loading the pattern image

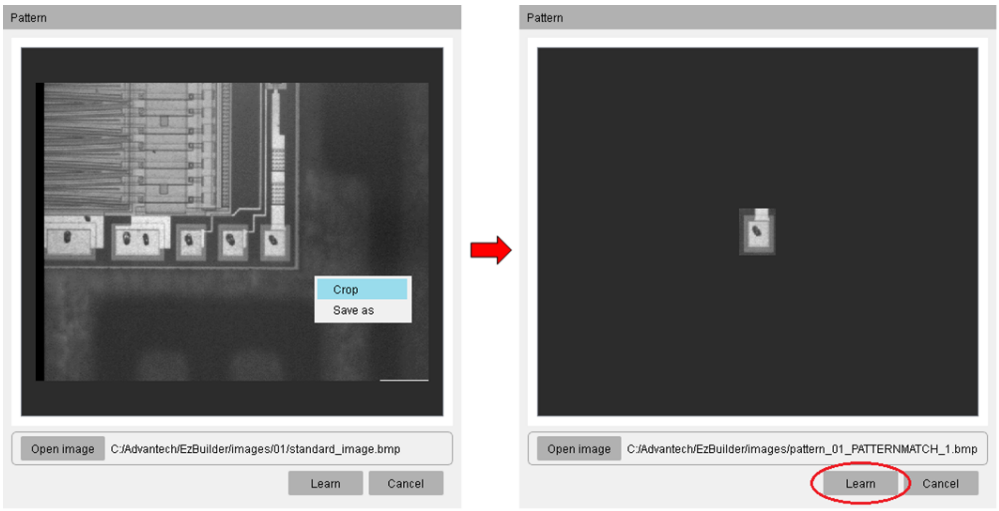


- ***Min. Reduce Area:*** To achieve acceptable time performance, this parameter stipulates the minimum number of pixels of the pattern image to be kept. The smaller the value, the faster the matching process, but it may give unreliable results. The default value (64) is usually a good compromise.
- ***Filtering:*** There are two filtering modes: 1) low-pass and 2) uniform. If the image has sharp gray-level transitions, it is better to choose a low-pass kernel instead of the usual uniform kernel.
- ***Pixel Dimension:*** When images are acquired with non-square pixels, rotated objects appear skewed. Taking the pixel aspect ratio into account can compensate for this effect.

3. Load the pattern image



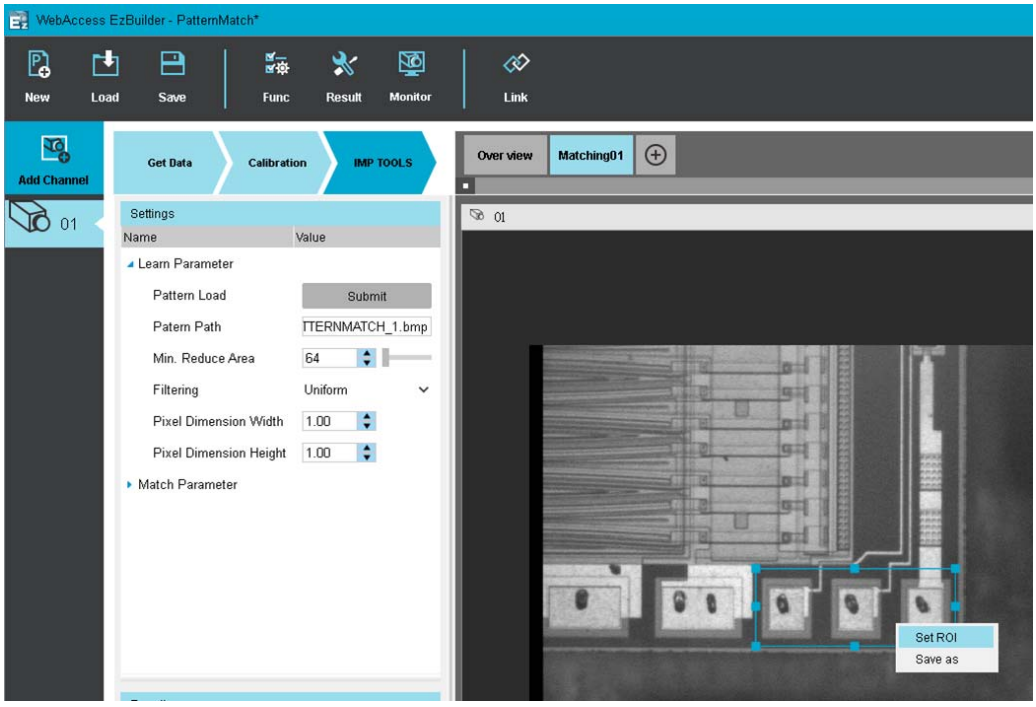
4. Crop the area you want to learn



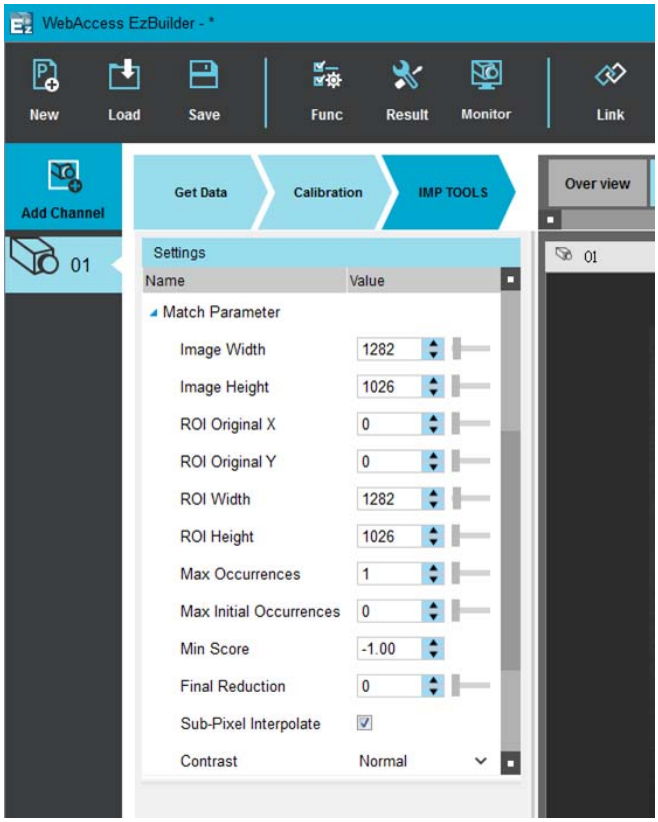
- ***Pattern Load:*** Load the pattern image and crop the area you want to learn.
- ***Learn:*** Start learning the image. Note: The learning pattern should be containing the object to be matched.
- ***Pattern Path:*** The file path of pattern image.

5.5.2 Matching Process

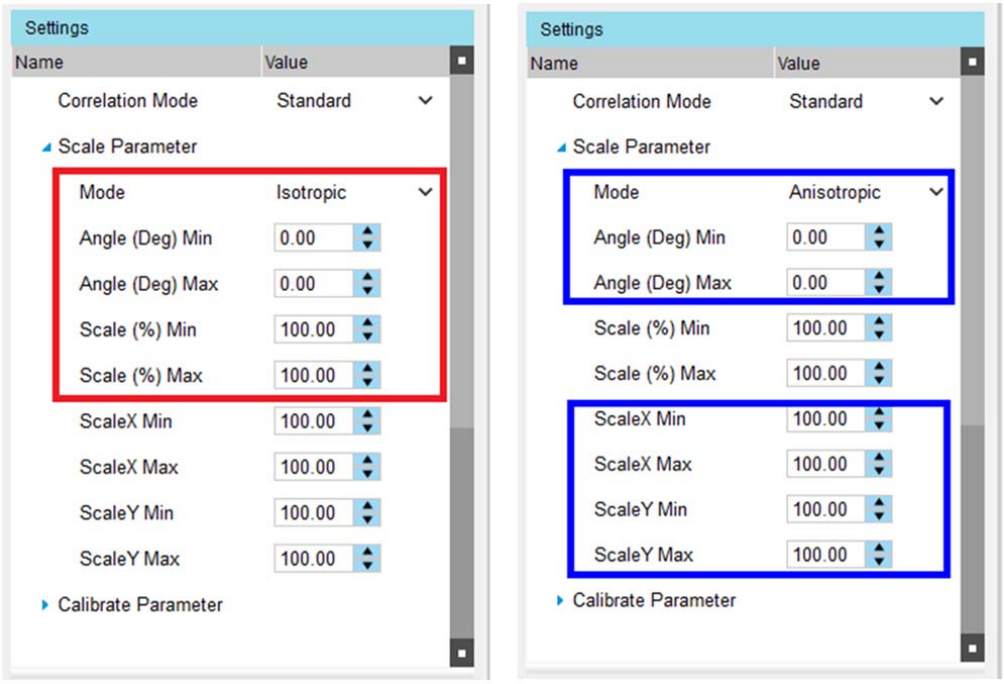
1. Using an ROI can accelerate the matching process by avoiding interference from the remainder of the image. The number of pixels to consider can thus be reduced



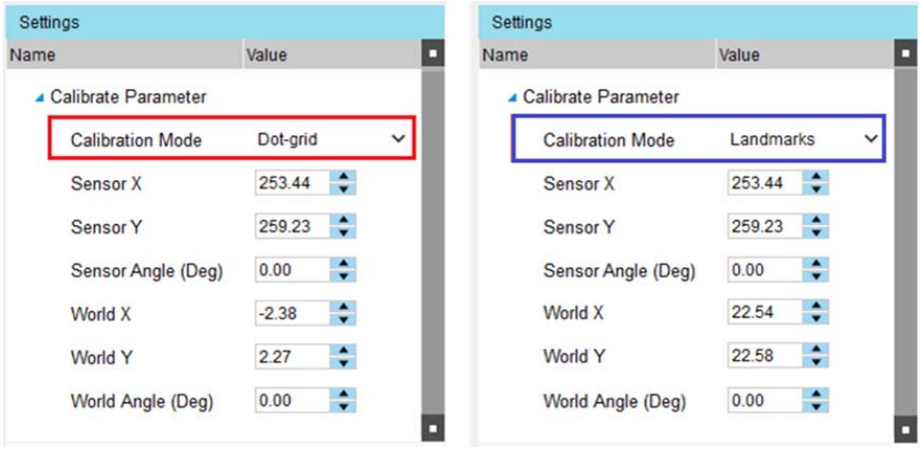
2. Tune the relevant matching parameters to ensure the pattern is found reliably.



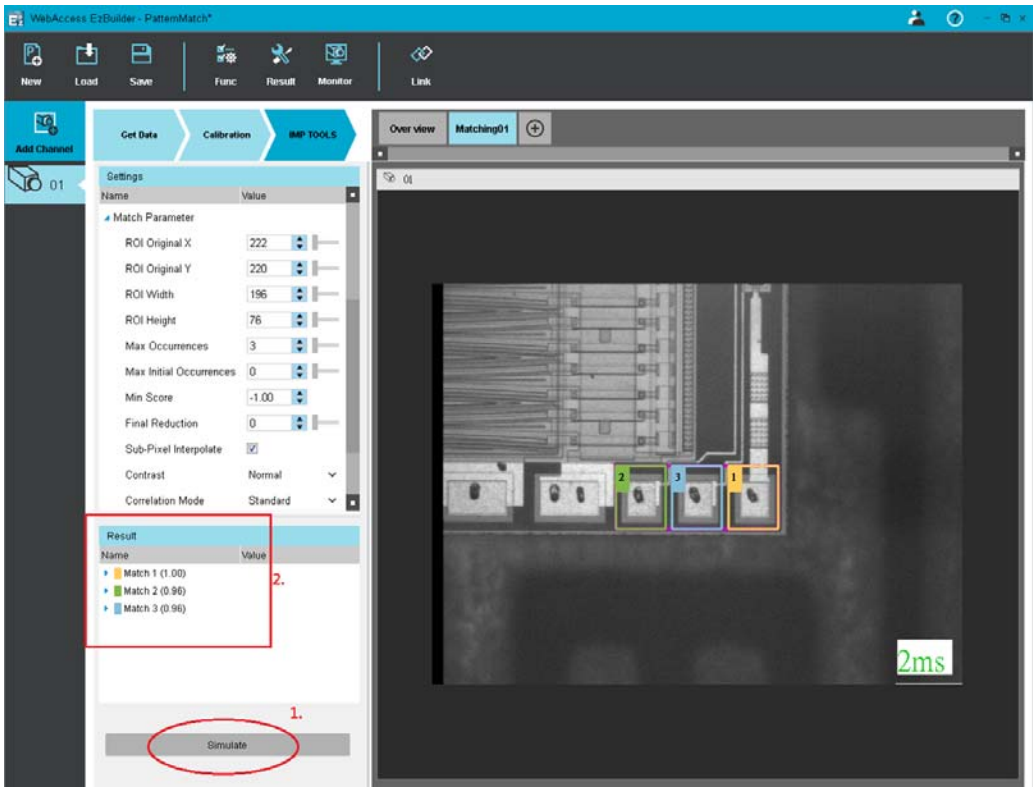
- ***Max Occurrences:*** Maximum number of objects to be matched.
- ***Max Initial Occurrences:*** The minimum quantity of objects to be matched.
- ***Min Score:*** The threshold under which a match is considered false and is discarded (range: -1 to 1).
- ***Final Reduction:*** Number of reduction steps. Can speed up matching when the coarse location is sufficient (range: [0 ... NumReductions - 1]).
- ***Sub-Pixel Interpolate:*** The accuracy with which the pattern is measured can be chosen (the less accurate, the faster). By default, the position parameters for each degree of freedom are computed with a precision of a pixel. Lower precision can be enforced. One tenth-of-a-pixel accuracy can be achieved.
- ***Contrast:***
  - Normal: if points share the same contrast polarity.
  - Inverse: if points exhibit opposite contrast polarity.
  - Any: regardless of their respective contrast polarity.
- ***Correlation Mode:*** Correlation mode: Can be standard, offset-normalized, gain-normalized, and fully normalized. The correlation is computed on the basis of continuous tone values. Normalization copes with variable light conditions, automatically adjusting the contrast and/or intensity of the pattern before comparison.
- ***Scale Parameter:*** To find the best matches between the pattern and target image, the target is allowed to translate horizontally and vertically. Additionally, it can be allowed to rotate and/or change its scale in the X and Y directions simultaneously or independently. The rotation angle and scale factors vary according to a user-specified interval. All degrees of freedom can be combined at will.
  - Rotation range: MinAngle, MaxAngle
  - Scaling range: MinScale, MaxScale
  - Anisotropic scaling range: MinScaleX, MaxScaleX, MinScaleY, MaxScaleY



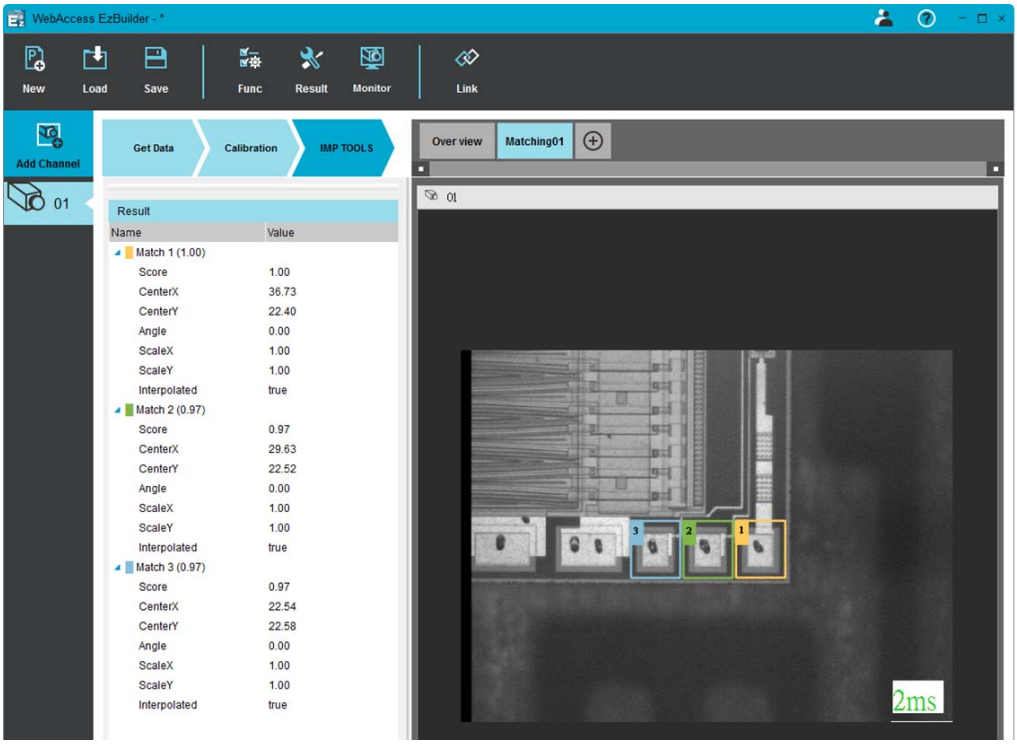
- ***Calibrate Parameter:*** After calibration has been performed, you can use the calibration result of dot-grid or landmark for further parameter configuration.



3. Perform a simulation and return the number of good matches found. A good match is defined as having a score higher than prescribed value (i.e., Min-Score).

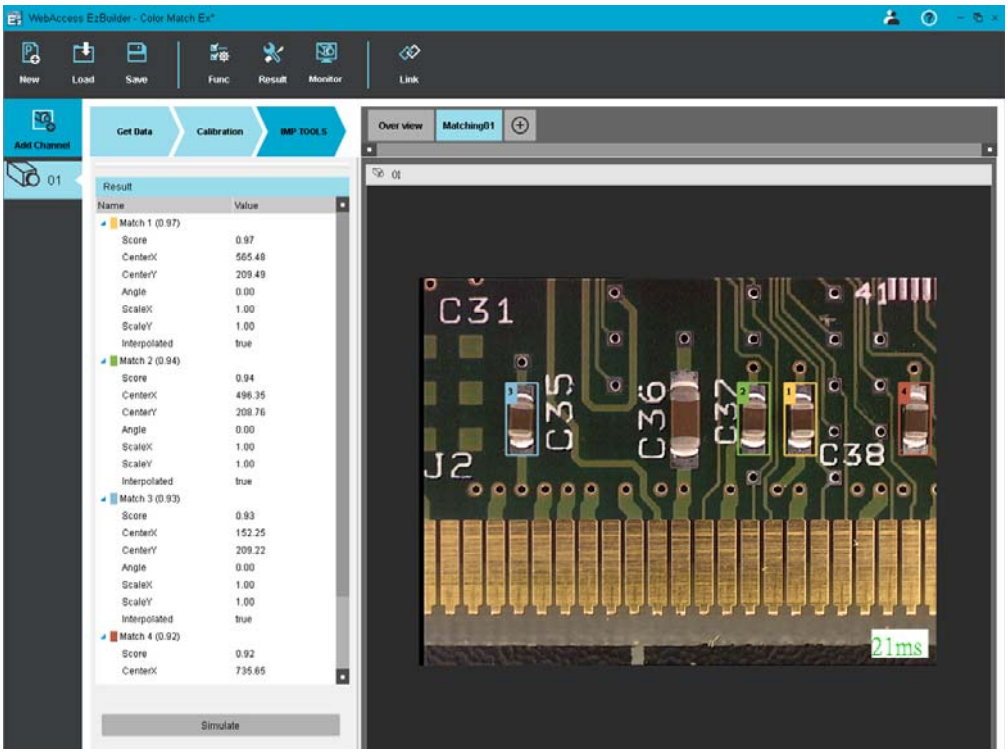


The result of the matching (with landmark calibration) is shown below:



Referring to the above process, you can perform color matching on your own.

Color Match Example:



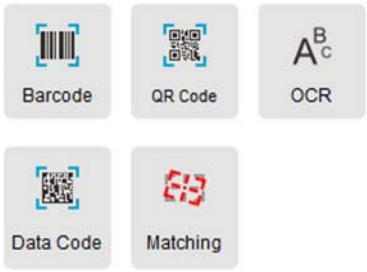
Chapter 6

Result Setting

6.1 Overview

EzBuilder provides a user-friendly editing interface, allowing users to perform logic and arithmetic operations on the immediate output results of certain IMPs.

The result settings support the output results of the following five IMP modules:



6.2 IMP Output Parameters

Following are IMP modules output result definition (Channel 01 is used as an example here)

IMP Module	Output Parameter	Data Type
Bar Code	CH01.Barcode01	String
QR Code	CH01.QRCode01.QRCnt	Integer
	CH01.QRCode01.Code0	String
	If the QRCnt more than one: CH01.QRCode01.Code1 CH01.QRCode01.Code2 ……	String
Data Code	CH01.DataCode01	String
OCR	CH01.OCR01	String
Pattern Match	CH01.PatternMatch01.MatchCnt	Integer
	CH01.PatternMatch01.Match0.Score	Float
	CH01.PatternMatch01.Match0.X	Float
	CH01.PatternMatch01.Match0.Y	Float
	CH01.PatternMatch01.Match0.A	Float
	If the MatchCnt more than one: CH01.PatternMatch01.Match1.Score CH01.PatternMatch01.Match1.X ……	Float

6.3 Start Result Setting

The result settings configuration is divided three parts.

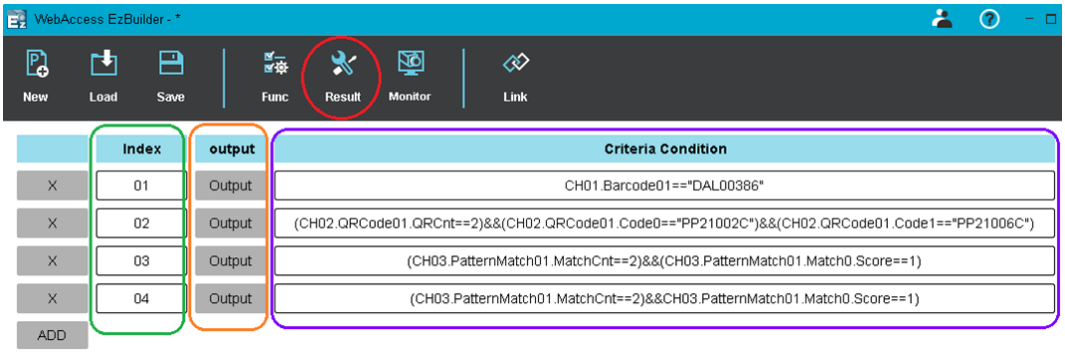
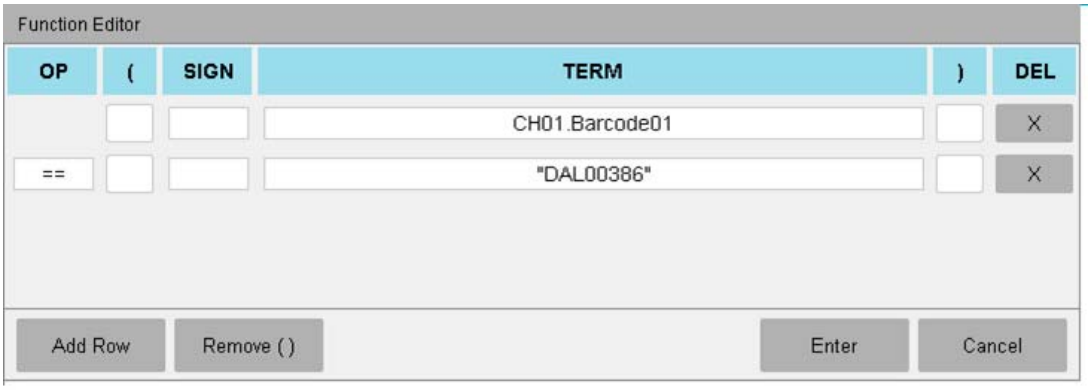


Figure 6.1 Result Settings Index, Output, & Criteria Condition

1. Criteria condition:

Click **ADD** to edit the criteria condition. For example, to check the barcode of channel ID 1 in every cycle, you could type the IMP output parameter in the **TERM** field, then add a new line to enter the expected result, and then select the equals operator.



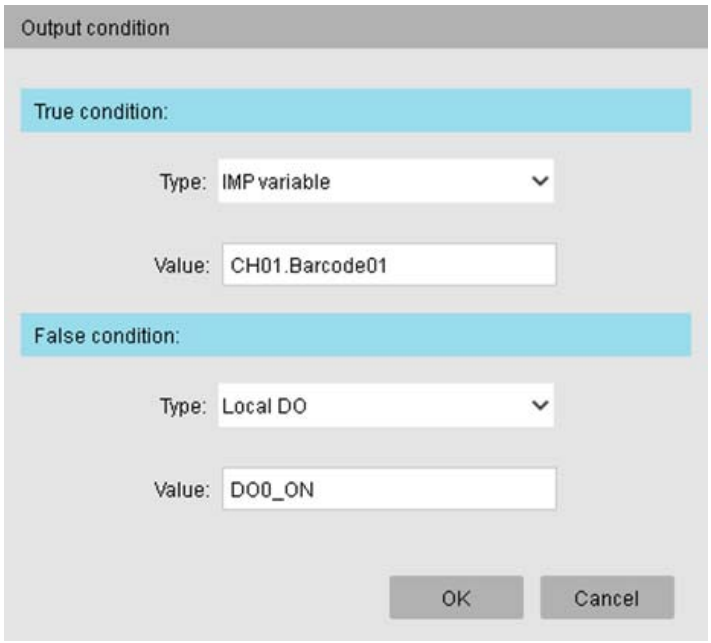
The relevant fields of the function editor are as follows:

Item	Description
OP	Logic and arithmetic operators
(	Left parentheses
SIGN	negative sign
TERM	Input IMP output parameter (see section 6.2)
)	Right parentheses
DEL	Delete one row
Add Row	Add new row
Remove ( )	Enable parentheses delete
Enter	Editing is completed.
Cancel	Edit canceled

2. **Output:** True or false output settings for the criteria condition.

Following the previous example, the conditions of TRUE and FALSE can be described in the output conditions. In this example, the IMP variable will be output

when the criteria condition is satisfied, and a Local DO ID 0 will be output when the criteria condition is not satisfied.



The relevant fields of the output editor are as follows:

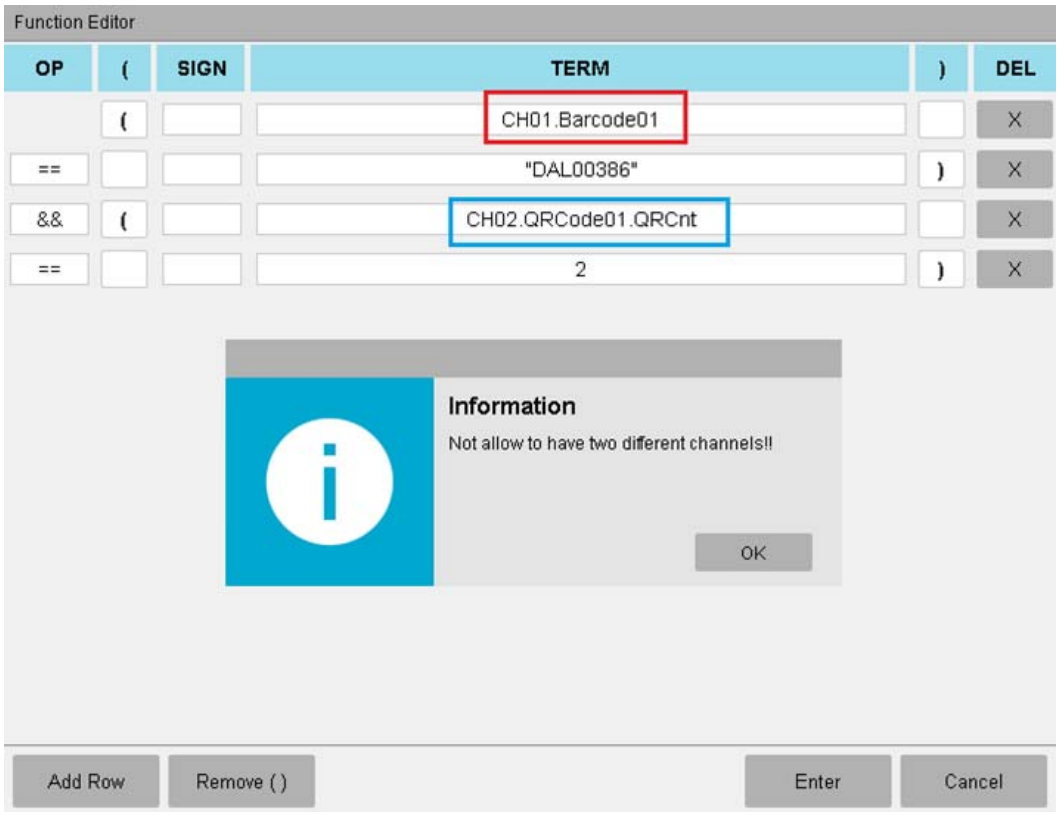
Type	Value
IMP variable	Refer to IMP output parameters.
String	Enter a string as output value
number	Enter a number as output value
Local DO	Select a DO_ON or DO_OFF as output value

3. **Index:** The global variable storage the output value of execution result of the criteria condition. The Index ID starts at 1.

After the criteria condition and true or false output settings have been completed, the index ID will be updated at every execution channel cycle time. These index ID data will be transmitted to the external device by the Link module via network or RS-232 communication. Please see the link module operation for more details.

6.4 Limitation on Result Settings

Result setting function only supports one channel IMP output because of the synchronization limitation.



6.5 Result Setting Demo

The following uses PatternMatch as a demonstration and outputs the X and Y coordinates of the matching object.

1. The matched result is as follows:

IMP Output Parameter	Value	Type
CH01.PatternMatch01.MatchCnt	1	Integer
CH01.PatternMatch01.Match0.Score	0.97	Float
CH01.PatternMatch01.Match0.X	29.63	Float
CH01.PatternMatch01.Match0.Y	22.52	Float

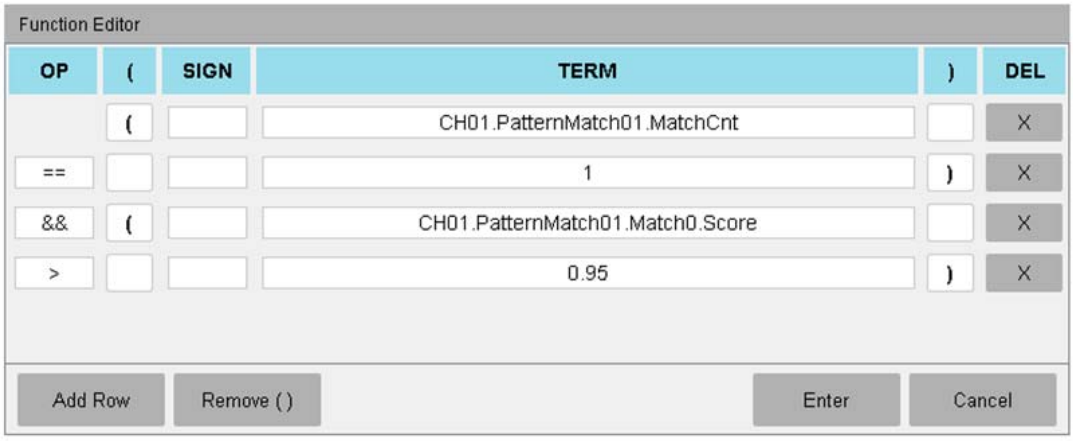
2. The pseudocode of criteria condition will be:

```
If (CH01.PatternMatch01.MatchCnt == 1)&&(CH01.PatternMatch01.Match0.Score > 0.95)
    INDEX01 = CH01.PatternMatch01.Match0.X;
    INDEX02 = CH01.PatternMatch01.Match0.Y;
Else
    Trigger a Local DO0 ON;
```

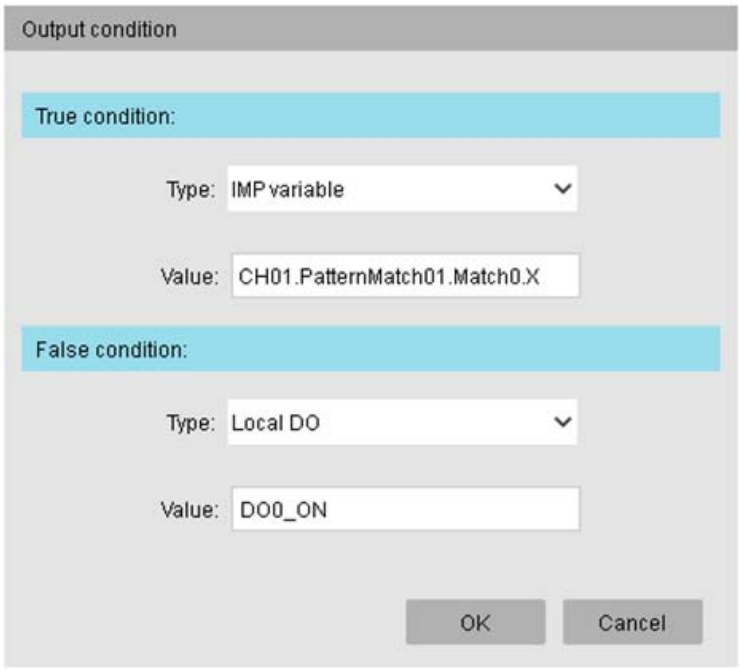
3. The result settings configuration will be:

INDEX 01: outputs the X coordinates of the matching object.

- Criteria Condition:

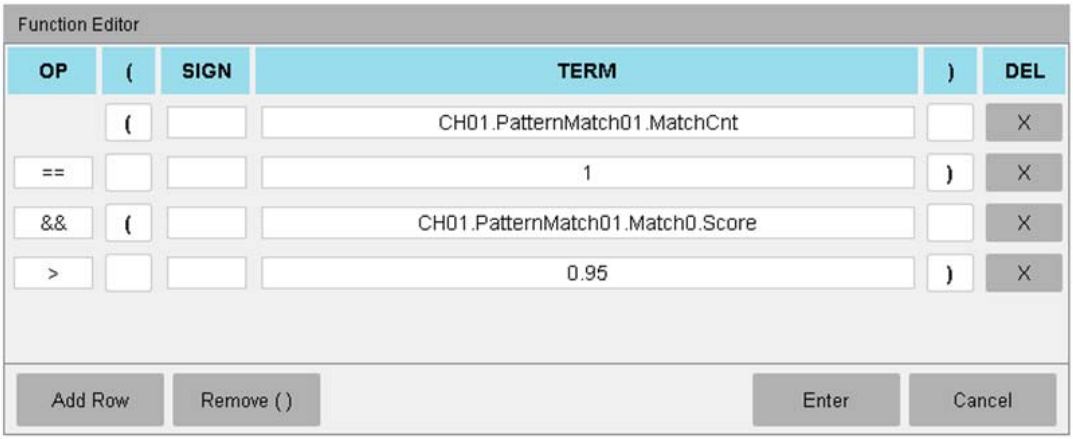


- Output Condition:

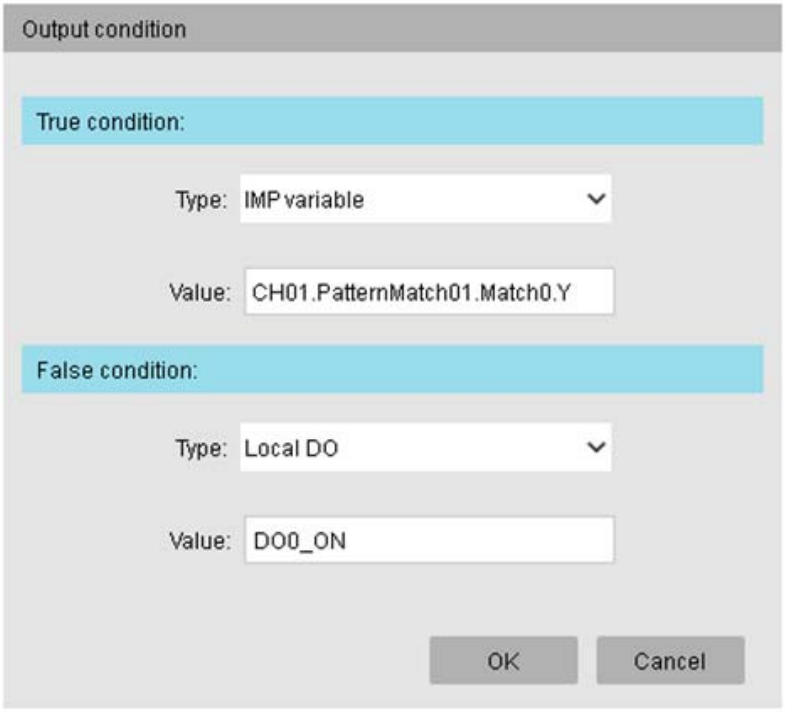


INDEX 02: outputs the Y coordinates of the matching object.

- Criteria Condition:



- Output Condition:



4. The completed configuration will appear as follows:

These index IDs will be updated at every execution channel cycle time.

Chapter 7

Digital I/O and Communication

EzBuilder provides a user interface to control hardware DIO on VPS-3100.

7.1 Digital Input

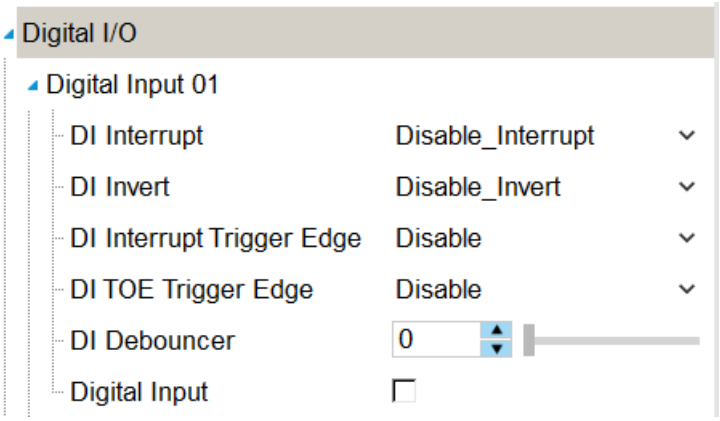


Figure 7.1 Digital Input Configuration Interface

Digital inputs support inverter and debouncer functions.

Inverter: Inverts the digital input signal.

Debouncer: Filters the signal and keeps the previous state if the signal width is less than the debouncer value.

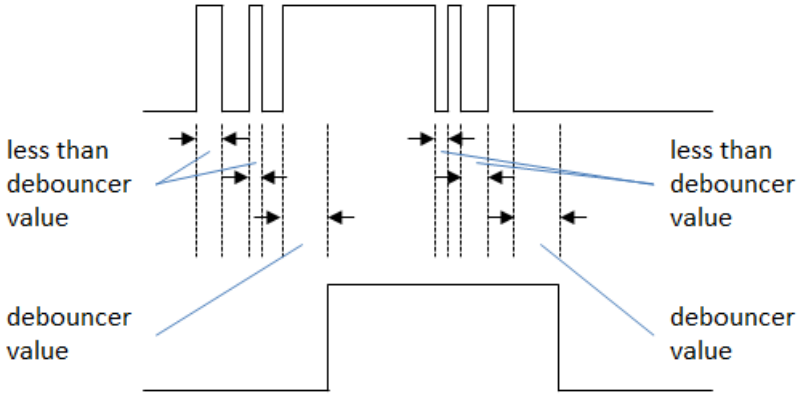


Figure 7.2 Digital Input Debouncer Example

7.2 Digital Output

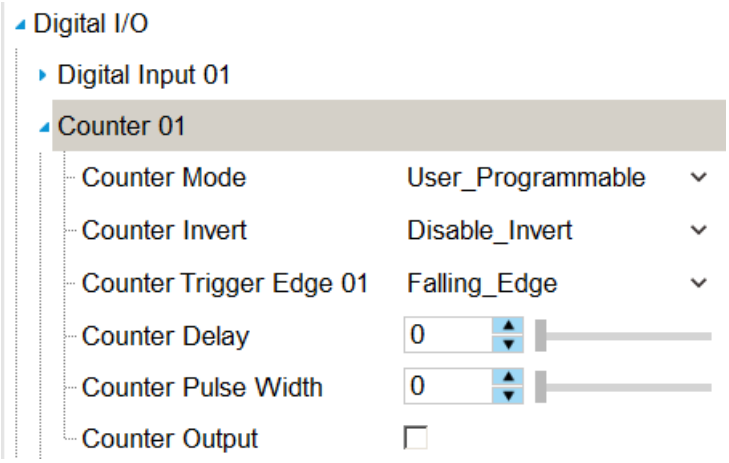


Figure 7.3 Digital Output Configuration Interface

Digital outputs support three modes. They are user-programmable mode, counter mode, and pass mode.

Digital outputs are set directly by the user in user-programmable mode.

Counter mode is a one-shot pulse generator and its source is the signal from the digital input port. To output a regular waveform via a digital output, the trigger type, delay, and width parameters are needed. Before the waveform is completely transmitted, any trigger signals are dismissed so that it can be seen as invalid for the digital output waveform generator.

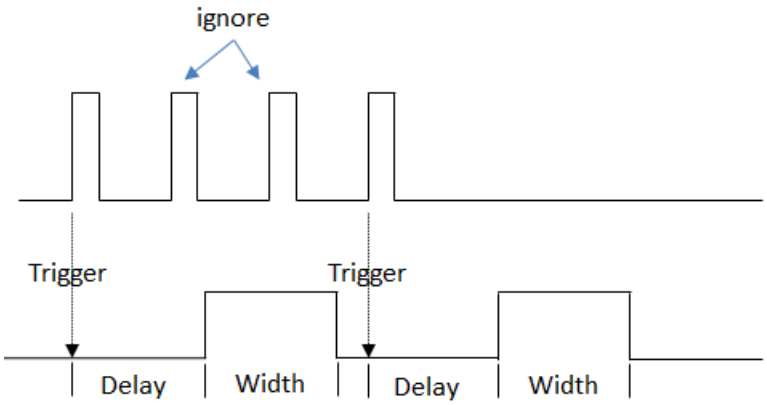


Figure 7.4 Counter Mode Example

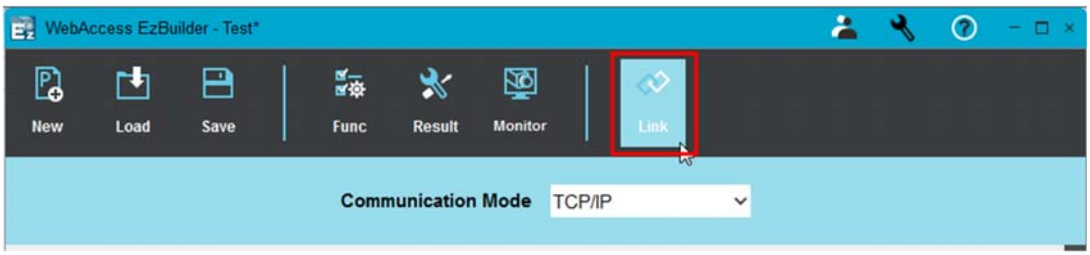
Pass mode is used to duplicate a signal from a digital input port and then send the signal out via a digital output port.

Digital output ports can also invert a signal when "Enable_invert" is configured.

7.3 Communication Mode

EzBuilder provides two communication protocols to link remote devices via TCP/IP and serial COM port.

Tip: Both communication methods send data to the network server but do not receive data from the network server.



7.3.1 TCP/IP

Click **Link** and choose **TCP/IP** from the **Communication Mode** field.

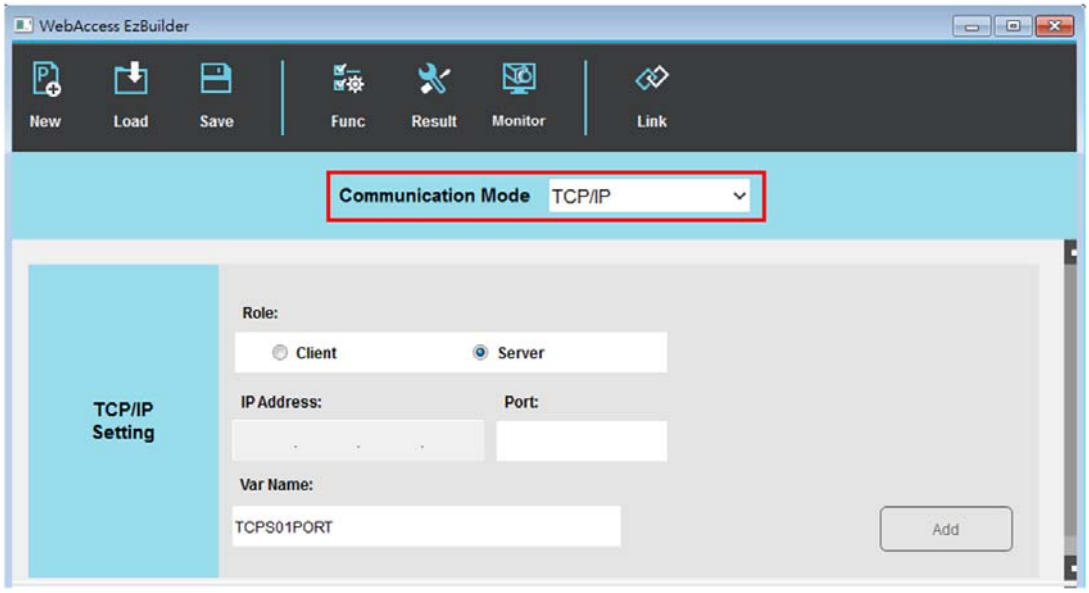
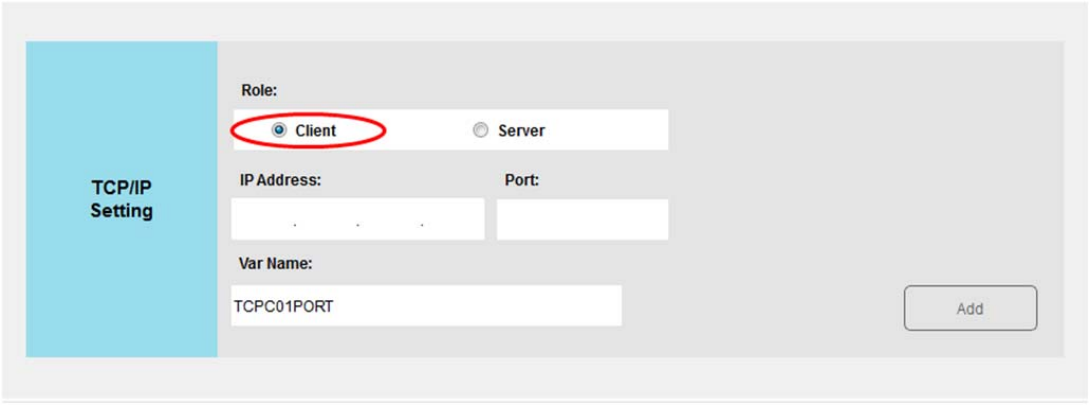


Figure 7.5 Setting up TCP-IP Communication

EzBuilder can be defined as the client or the server.

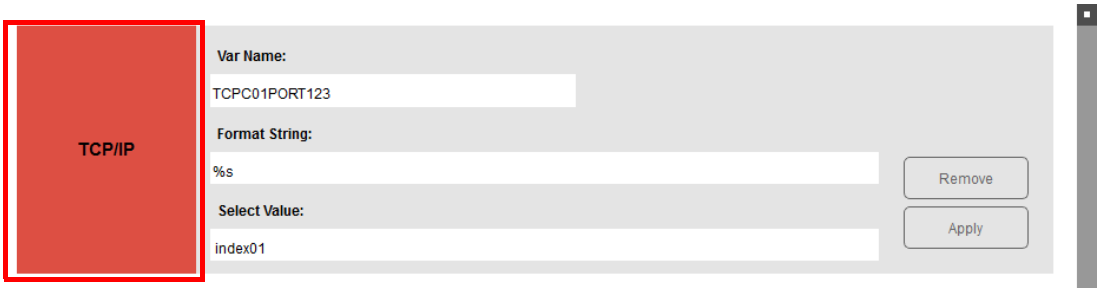
7.3.1.1 TCP/IP Client Settings

1. Choose **Client** from the **Role** panel inside the **TCP/IP Setting** panel.

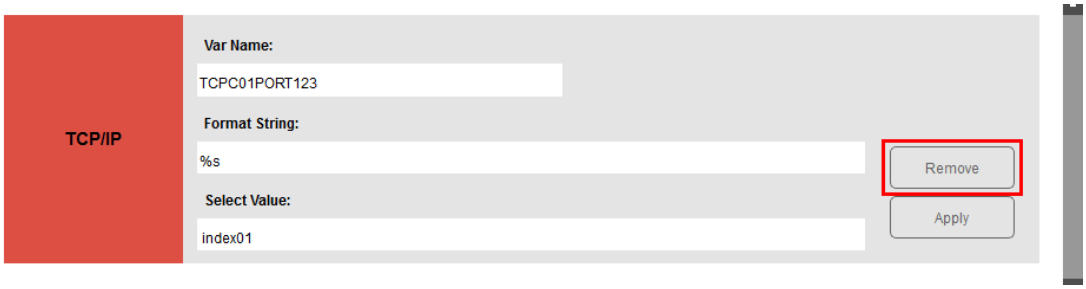


2. Enter the server IP address and port number to which data will be sent. EzBuilder will automatically generate the name of the link node.

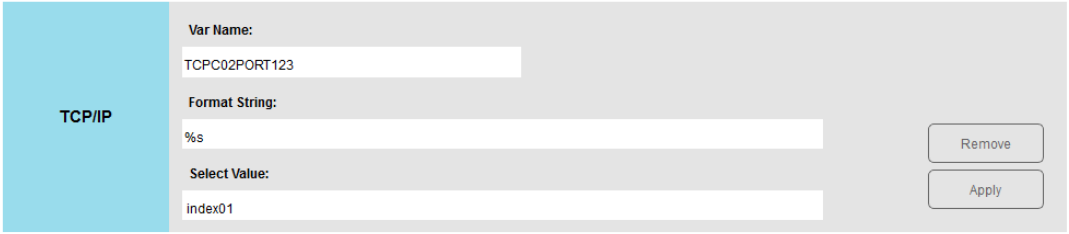
After you click **Add**, TCP/IP communication will start. If communication has failed, the color of node will change to red.



In this situation, click **Remove** to delete the node.

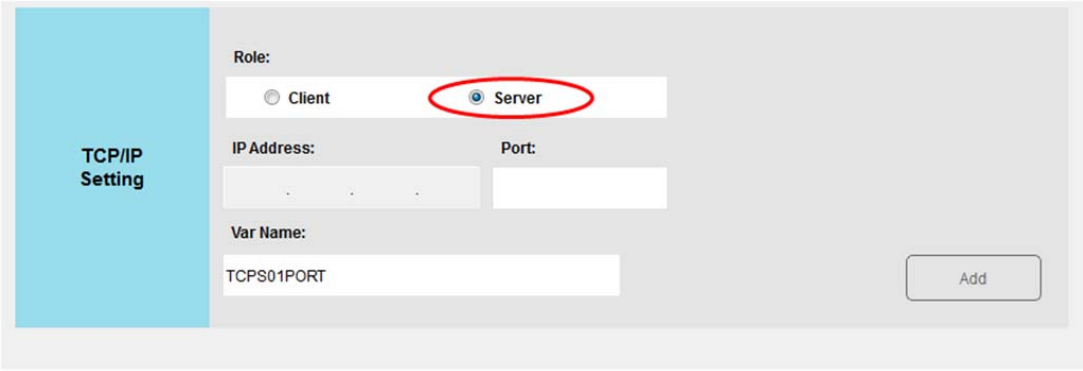


The following will appear when communication is successful:

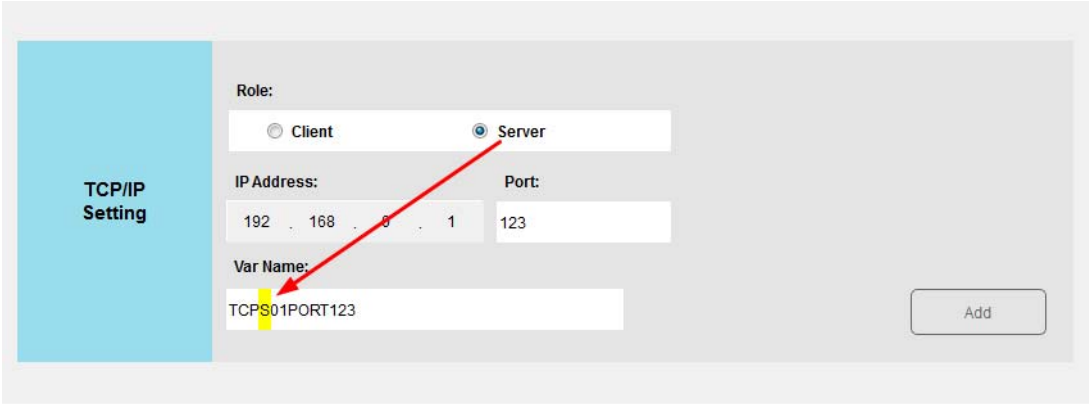


7.3.1.2 TCP/IP Server Settings

When server is selected, you do not need to enter an IP address.

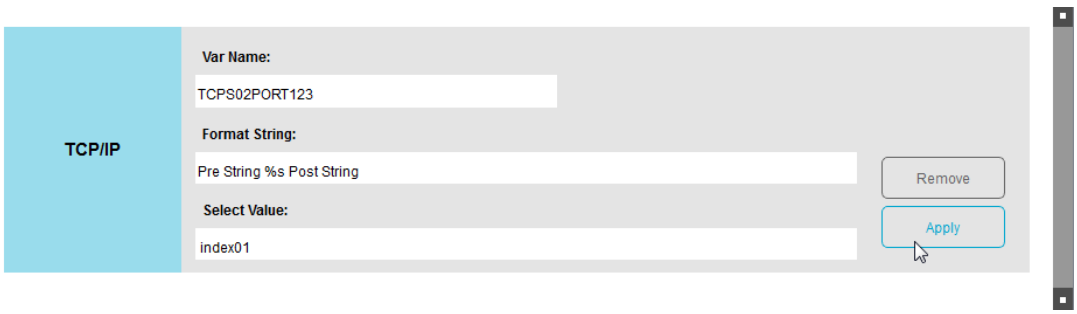


The **Var Name** will include an "S" when **Server** is selected and a "C" when **Client** is selected.

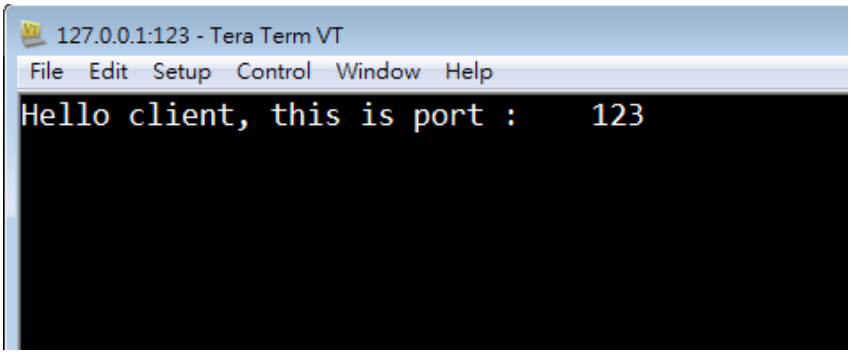


The following will appear when communication is successful.

For information on the **Format String** and **Select Value** fields, see Chapter 7-3.

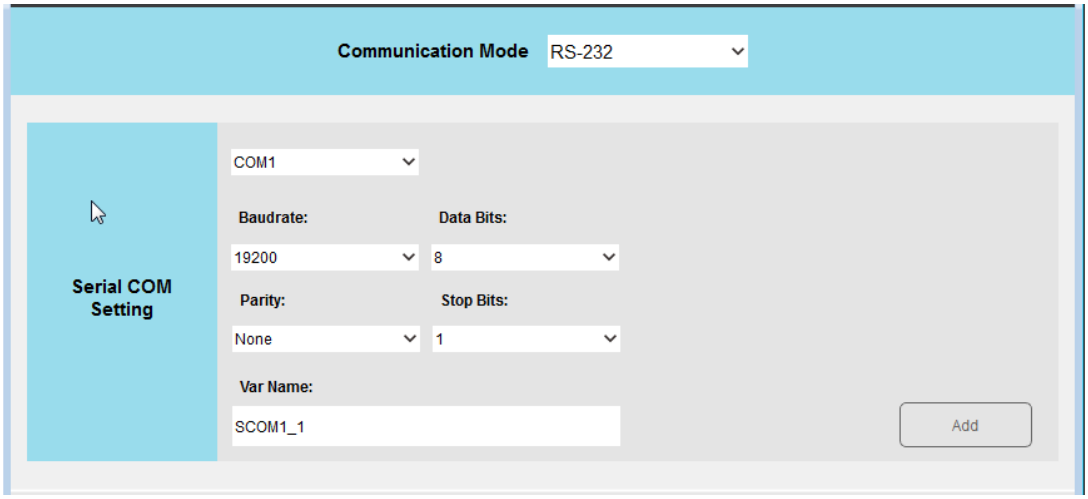


After a remote device has linked to the communication node, the following message will be received:



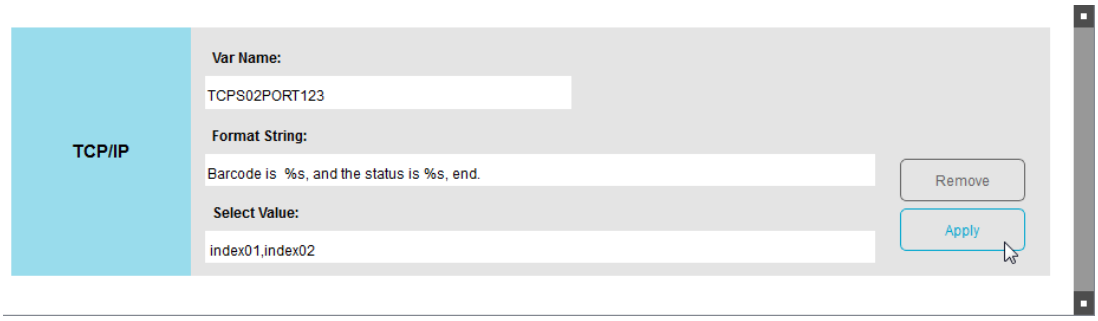
7.3.2 Serial Port Setting

Choose **RS-232** from the **Communication Mode** field and then set the port number and related parameters of the serial COM port.

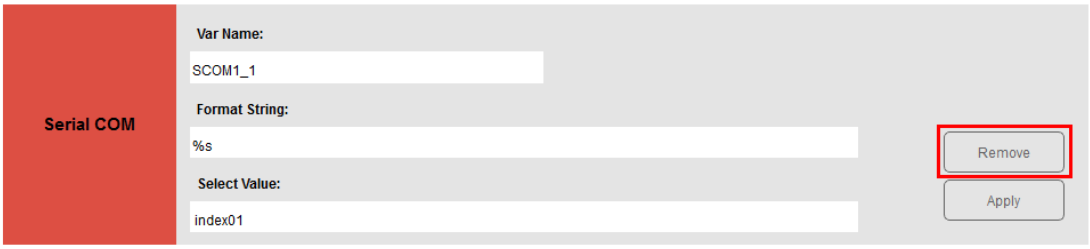


After you click **Add**, the serial COM will be opened.

For information on the **Format String** and **Select Value** fields, see Chapter 7.3.3



If a serial COM has been created, the color of the node will change to red. In this situation, click **Remove** to delete the node.



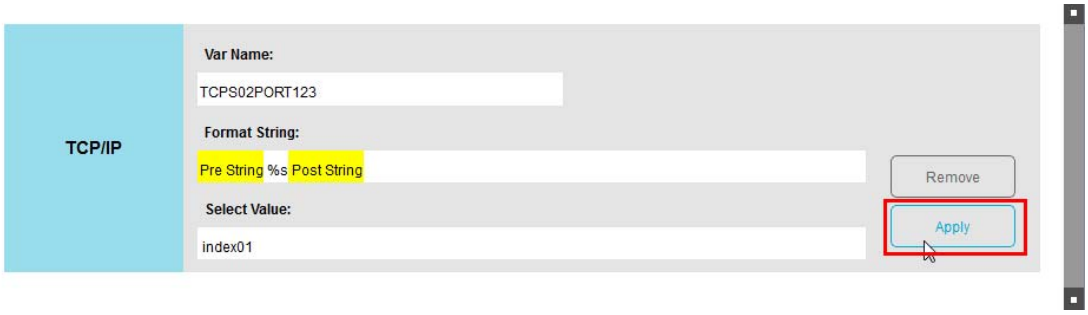
7.3.3 Format String and Select Value

The Format String and Select Value fields are related fields with string style.

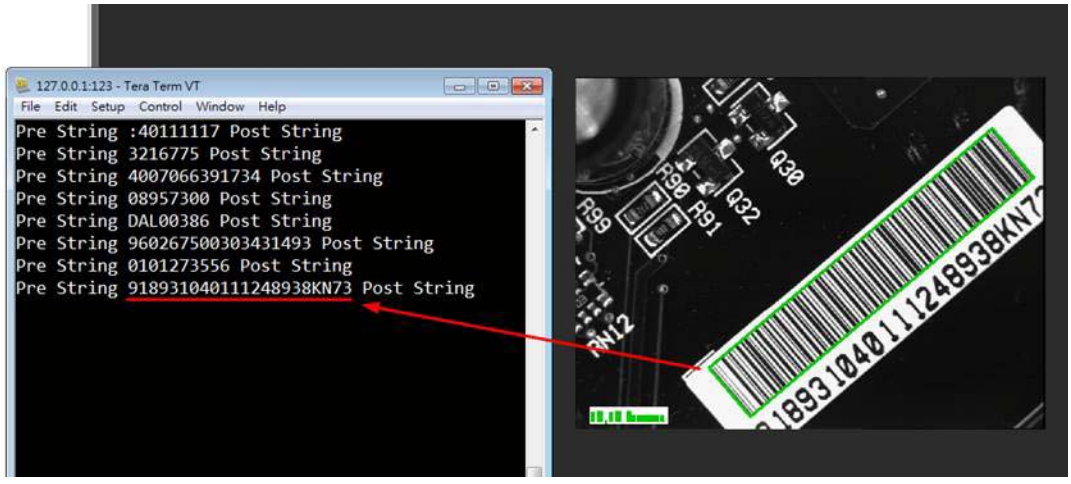
In the Format String field, you can enter the pre string and post string for data to be sent. The Format String field has two types of output values (i.e., string and float), %f and %s are used as insert values from the Select Value field.

Example 1

Here, the output value type of index01 is string, and so %s is used to send data.



Result Output

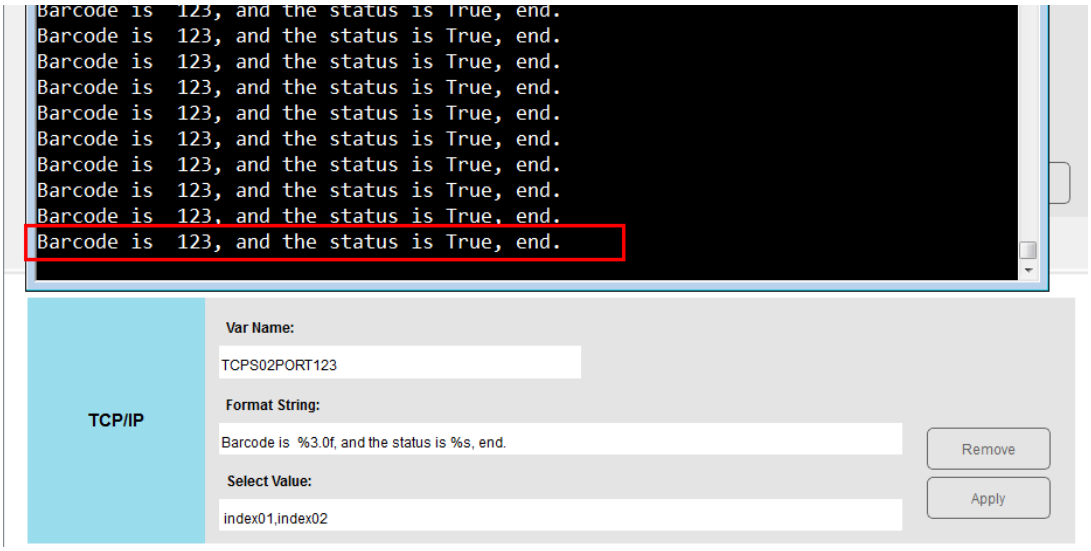


The **Format String** field also supports the sending of parameters to a communication node. Parameters are separated by a comma at the **Select Value** field.

Example 2

In this example, the output value types of index01 and index 02 are float and string, respectively. Accordingly, %f and %s are respectively used to send data.

Result Output



Reference for %f:

%m.n	Field width, precision
%-m.n	Left adjustment
%0m.n	Zero-padding
%*.*	Width and precision taken from arguments

Chapter 8

Project Management

8.1 Project Operation

Click **New**, **Load**, and **Save** to create, load, and save a project.

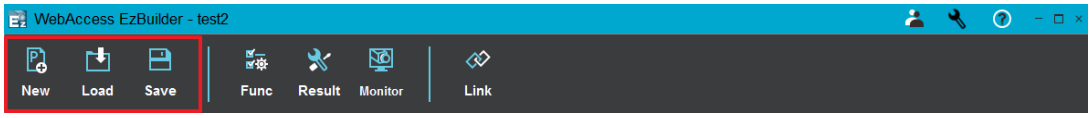


Figure 8.1 Project Management Toolbar

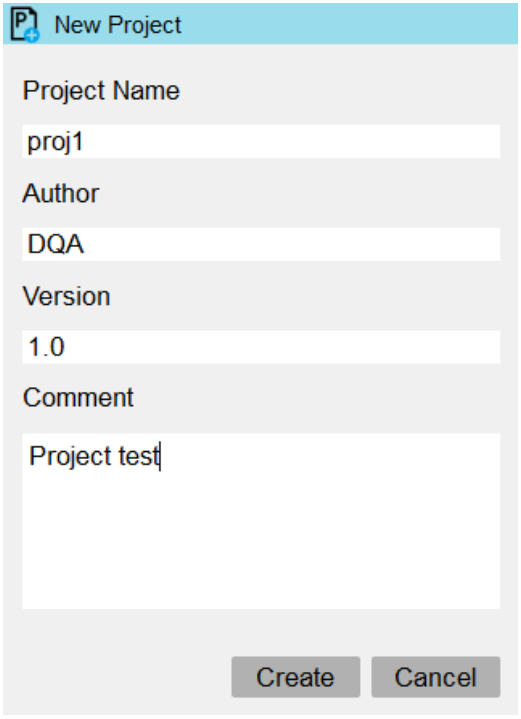


Figure 8.2 New Project

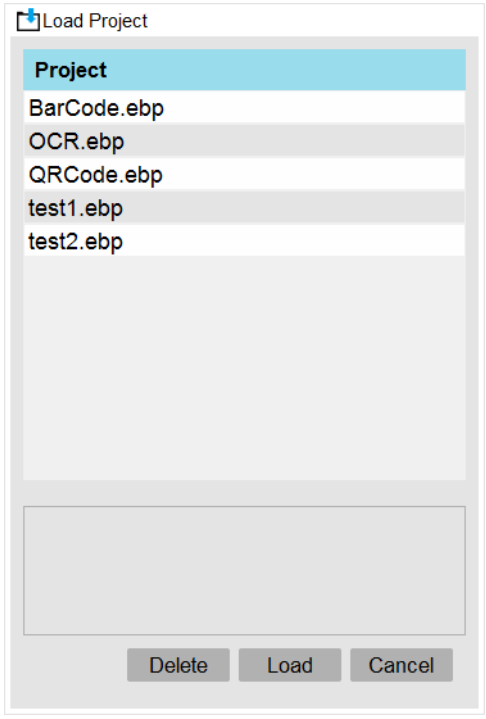


Figure 8.3 Load Project

When you create a project, you can save any changes by clicking **Save**. Ezbuilder will keep the changes to settings in a temporary database. Once you click **Save**, these changes will be updated in your current project.

These changes include:

1. All channels and the IMP tools in these channels.
2. Changes to any settings to **From File**, **From Camera**, **Calibrations**, and **IMP TOOLS**. However, the settings in the OCR font dialog are not included.
3. The content of **Result Settings**: criteria conditions and output conditions.
4. All link entries.

8.2 Runtime Mode/Development Mode

When EzBuilder starts, it will perform initialization and stay in user (runtime) mode. The right panel will show live images of each channel. The left panel shows the **Status** and **Result** panels. The **Status** panel shows the detected results of IMP tools for each channel; the **Result** panel shows whether the result of that channel is valid.

The result of the channel is valid on the condition that all the results of IMP tools on the channel are valid. You can load another project by clicking **Load** on the toolbar. Click **Start/Stop** on the toolbar to start/stop acquisition for all channels.

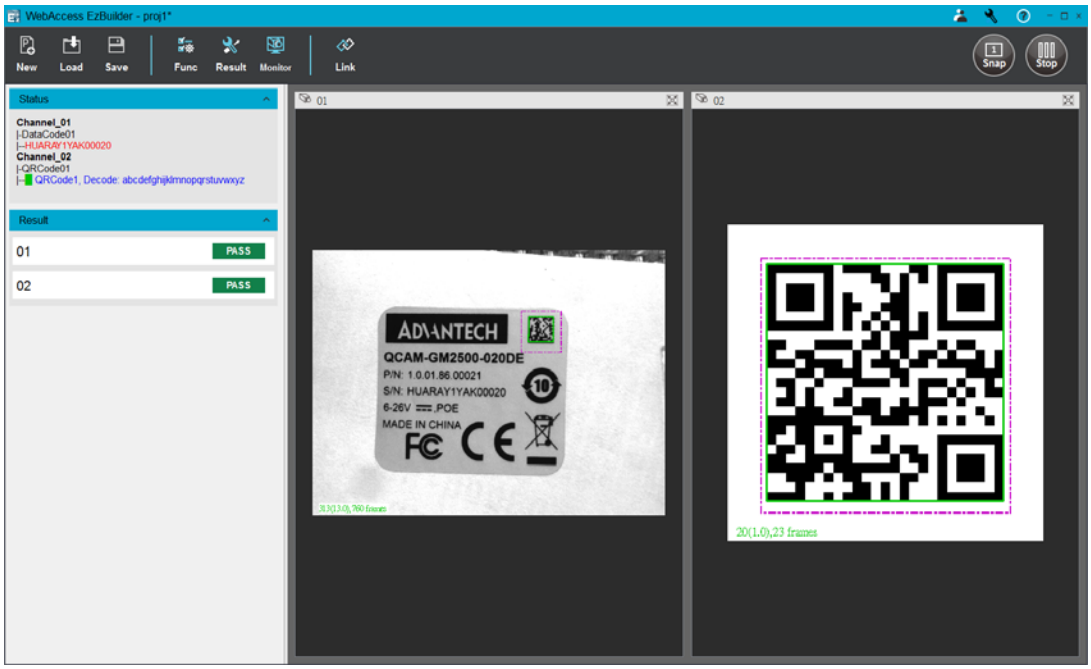
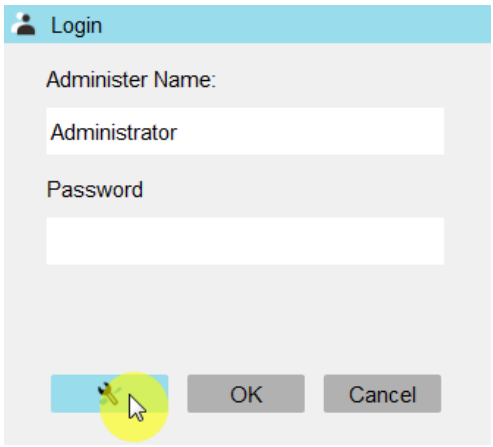


Figure 8.4 Switching to Runtime Mode

Click the **Login** icon to show the **Login** dialog box. Enter the administrator password to switch to development mode.



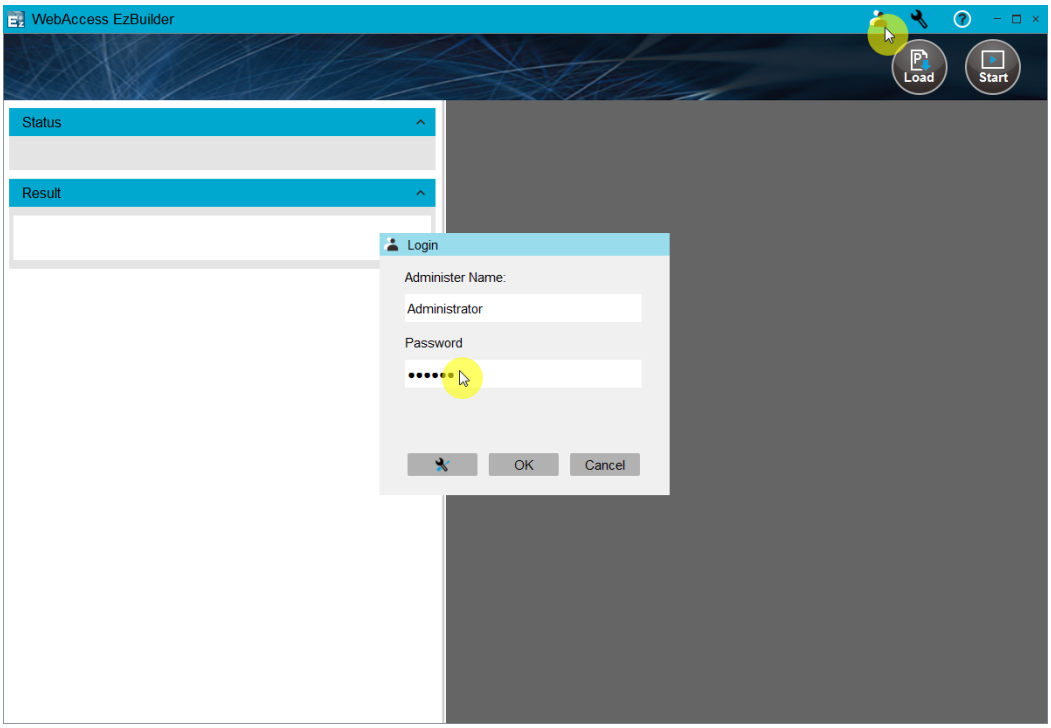
The default password is "123456". You can change the password by clicking the spanner at the bottom of the **Login** dialog box.

Chapter 9

Use Case

9.1 Traceability in Data Matrix Code

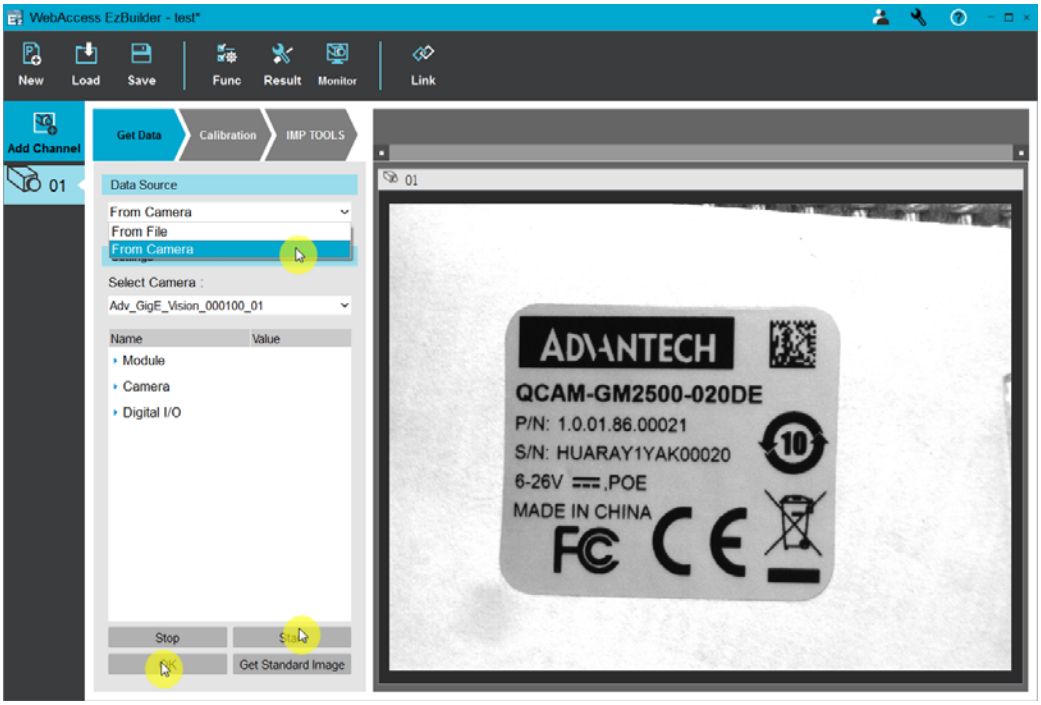
1. Start up EzBuilder, click the **Login** icon and enter the default password "123465".



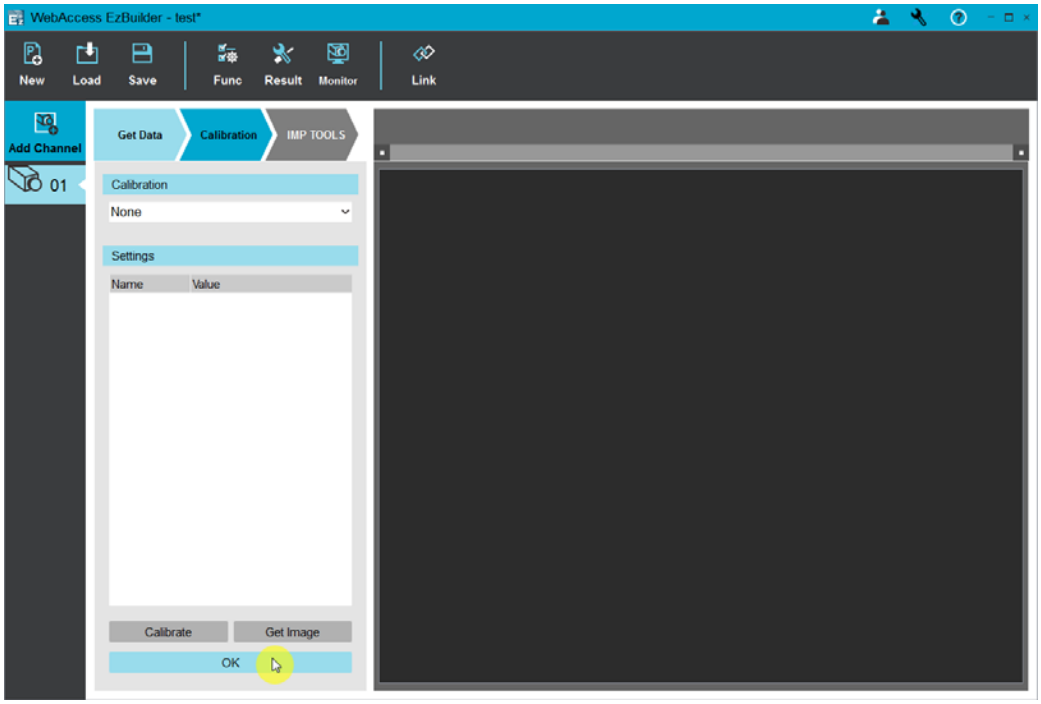
2. Click **New** in the toolbar, enter the project name, and then click **Create** in the **New Project** dialog box.

3. Click **Func** in the toolbar, then click **Add Channel**, and the click the button for the newly added channel.

4. Select **From Camera** under **Data Source** in the **Get Data** panel, and then click **Start** to start acquisition. You can adjust the desired position and focus of the camera. Click **Stop** to capture an image snapshot. Click **OK** to proceed to the next step.

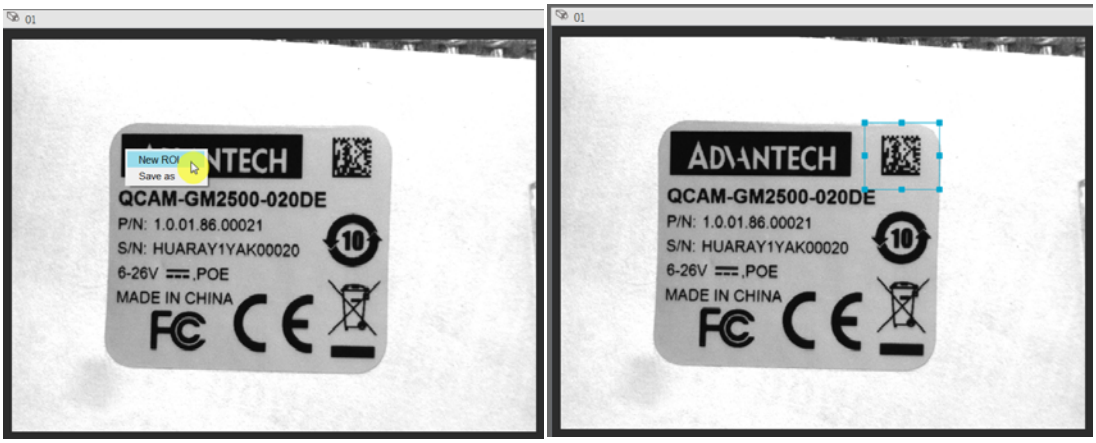


5. Click **OK** to skip the calibration.

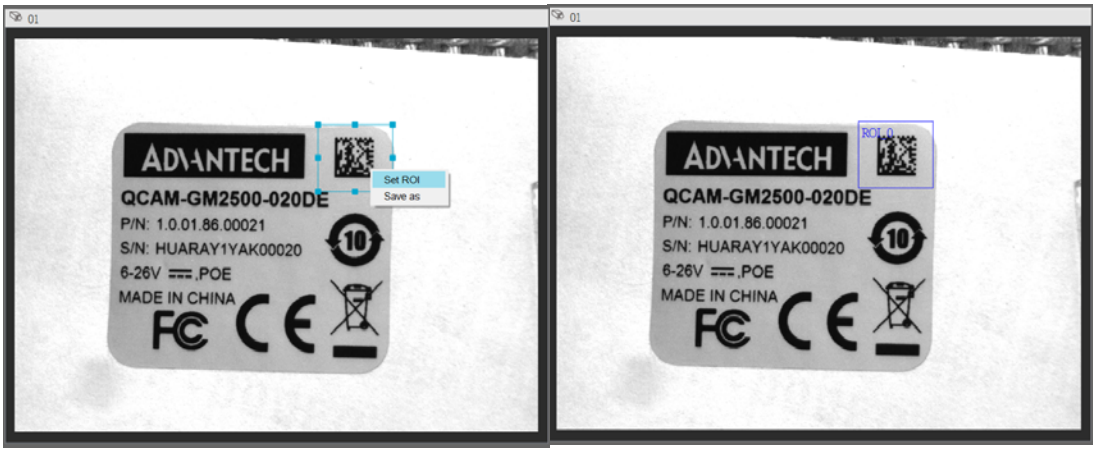


6. Click the **Add** icon ⊕ and select **Data Code** in the **IMP Tools** dialog box.

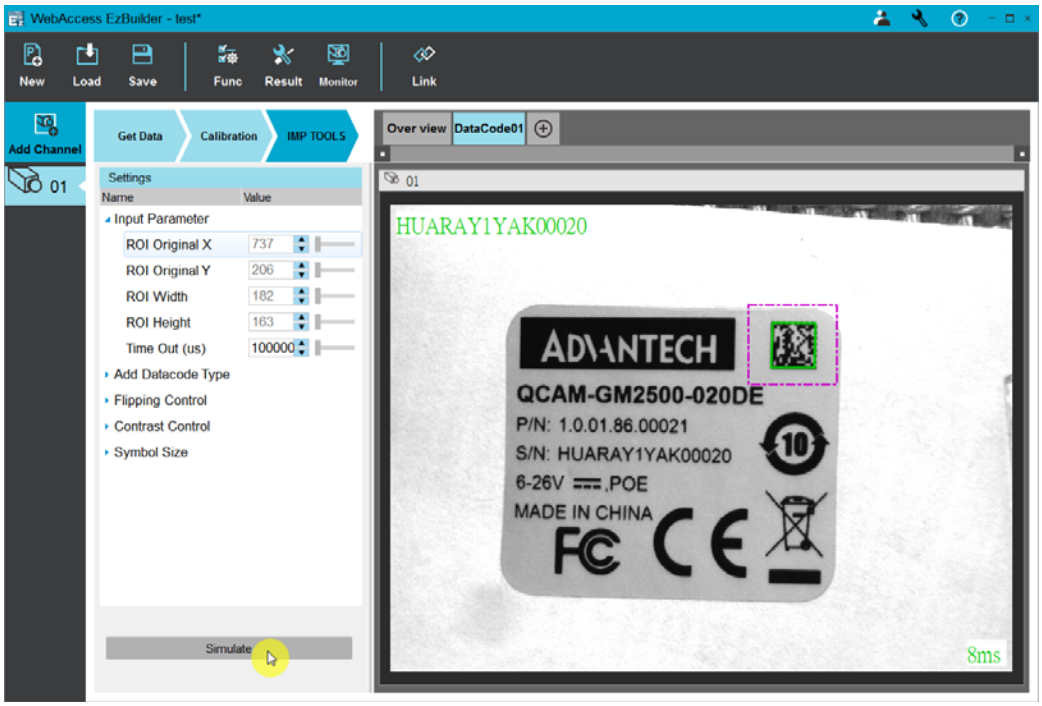
7. Right-click on the image and select **New ROI**. Drag the ROI corner and side handles to move the ROI to the required position.



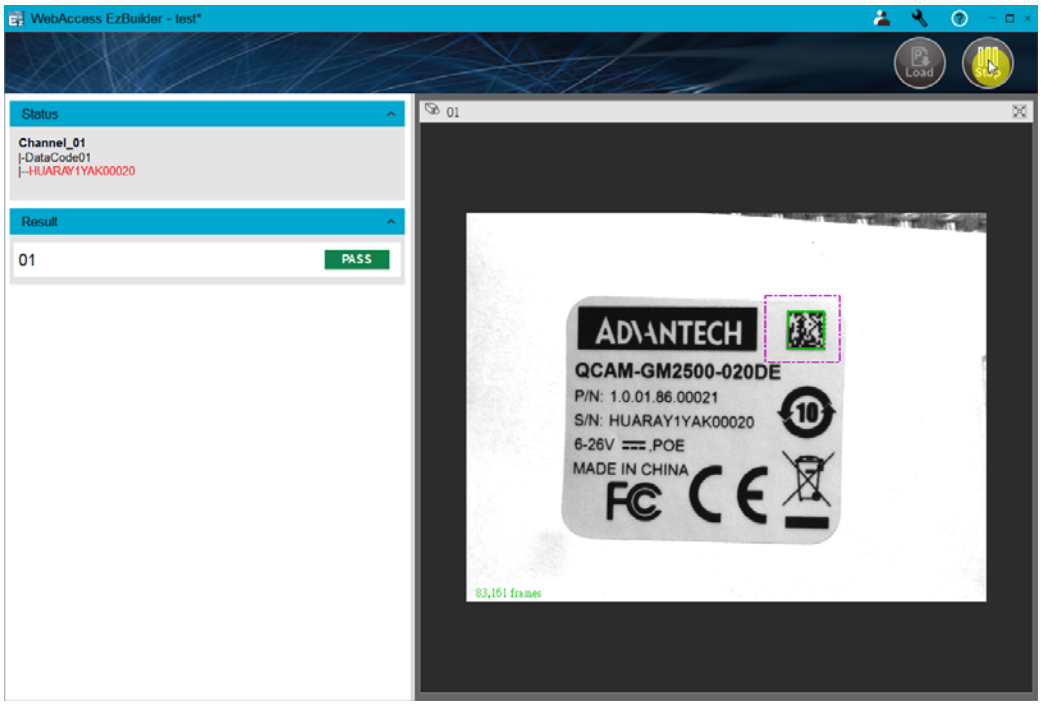
8. Right-click on the ROI and select **Set ROI**.



9. Click **Simulate**.

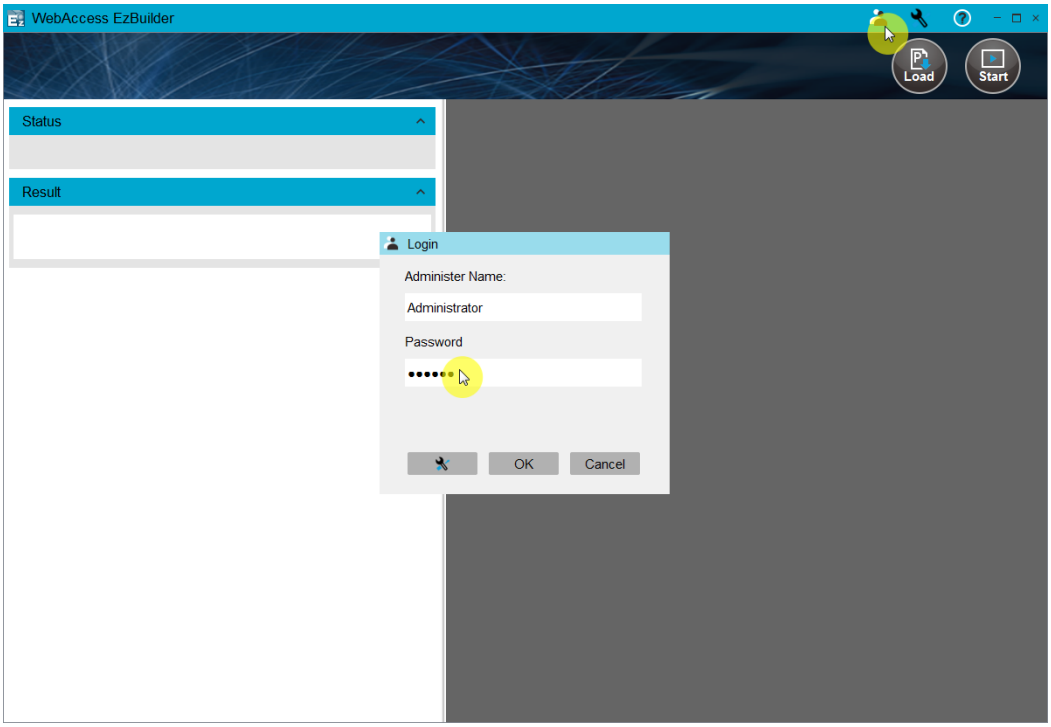


10. Click the **Login** icon to return to user mode and click **Start**.



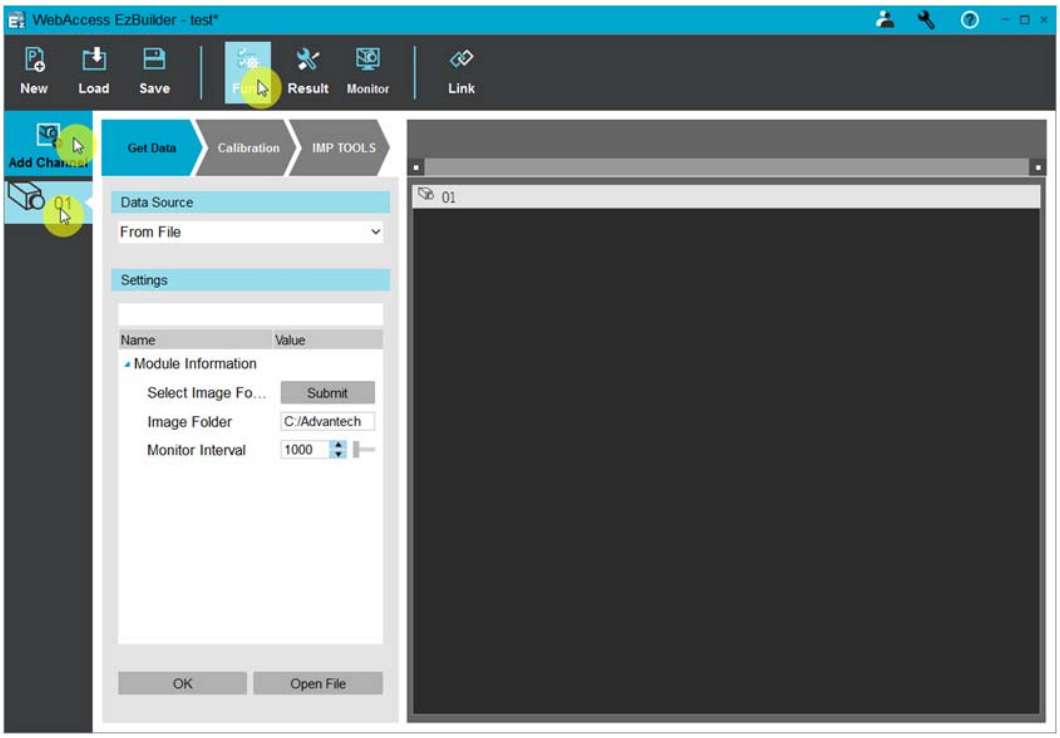
9.2 Alignment

1. Start up EzBuilder, click the **Login** button and enter (default: "123465").

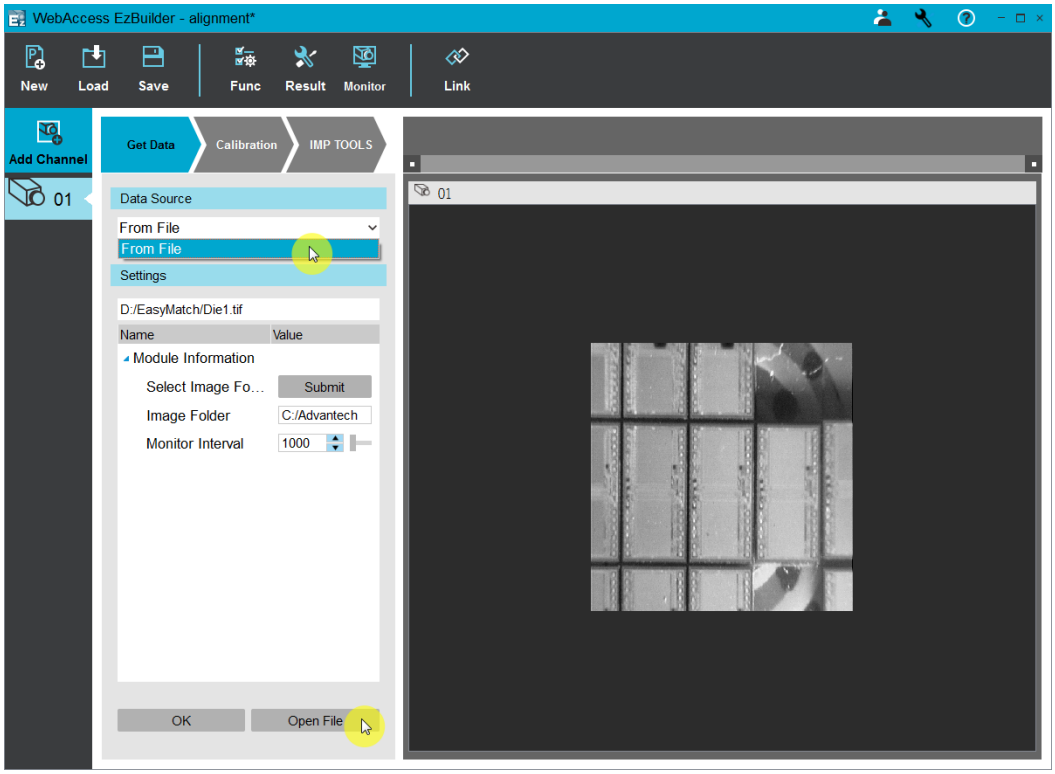


2. Click **New** in the toolbar, enter the project name, and click **Create** in the **New Project** dialog box.

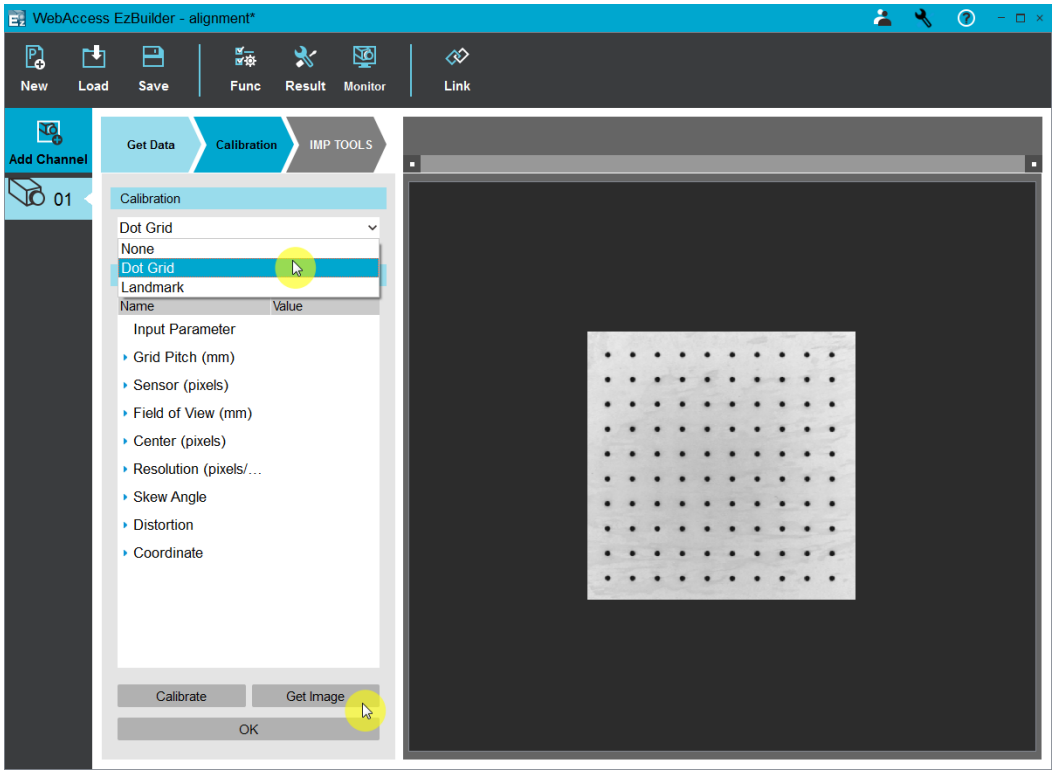
3. Click **Func** in the toolbar, then click **Add Channel**, and then click the newly added channel button.



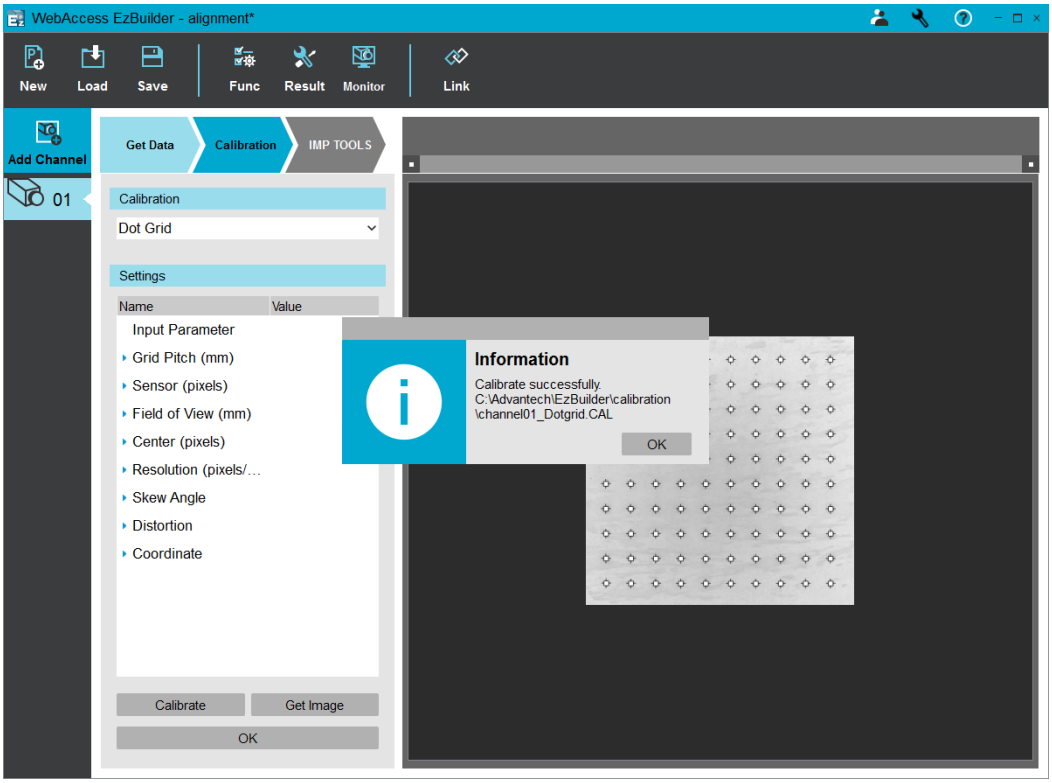
4. Select **From File** under **Data Source** in the **Get Data** panel, and then click **Open File** to select the desired image. Click **OK** to proceed to the next step.



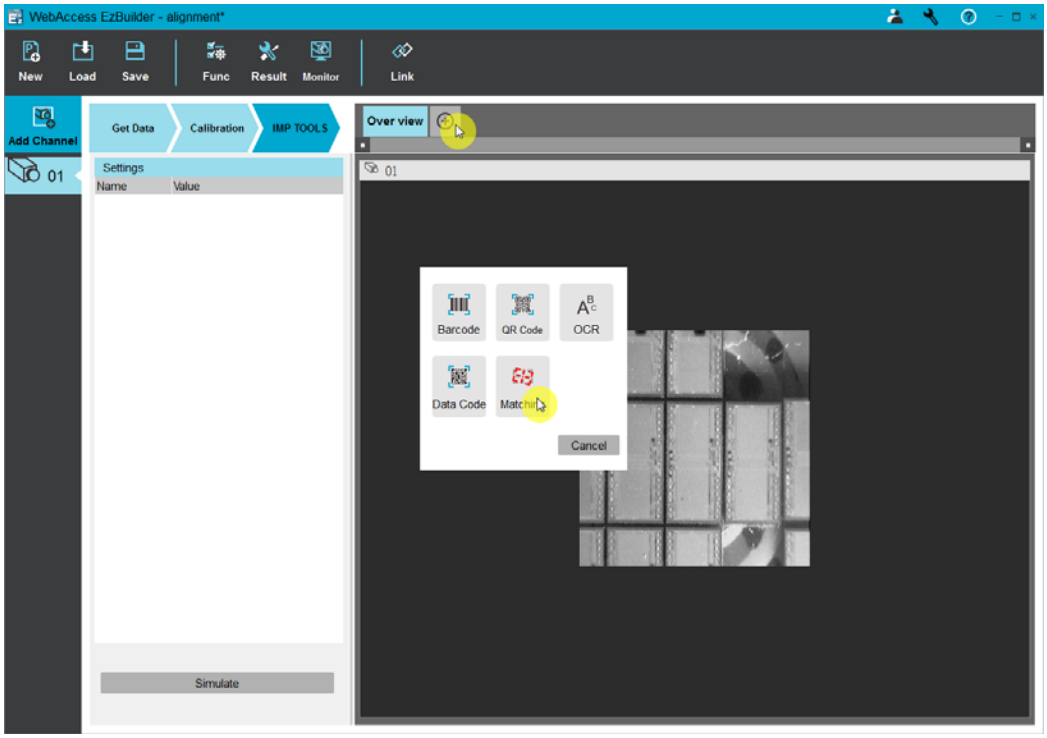
5. Click **Get Image** in the **Calibration** panel to select the desired image from storage. Select **Dot Grid** from the **Calibration** dropdown list.



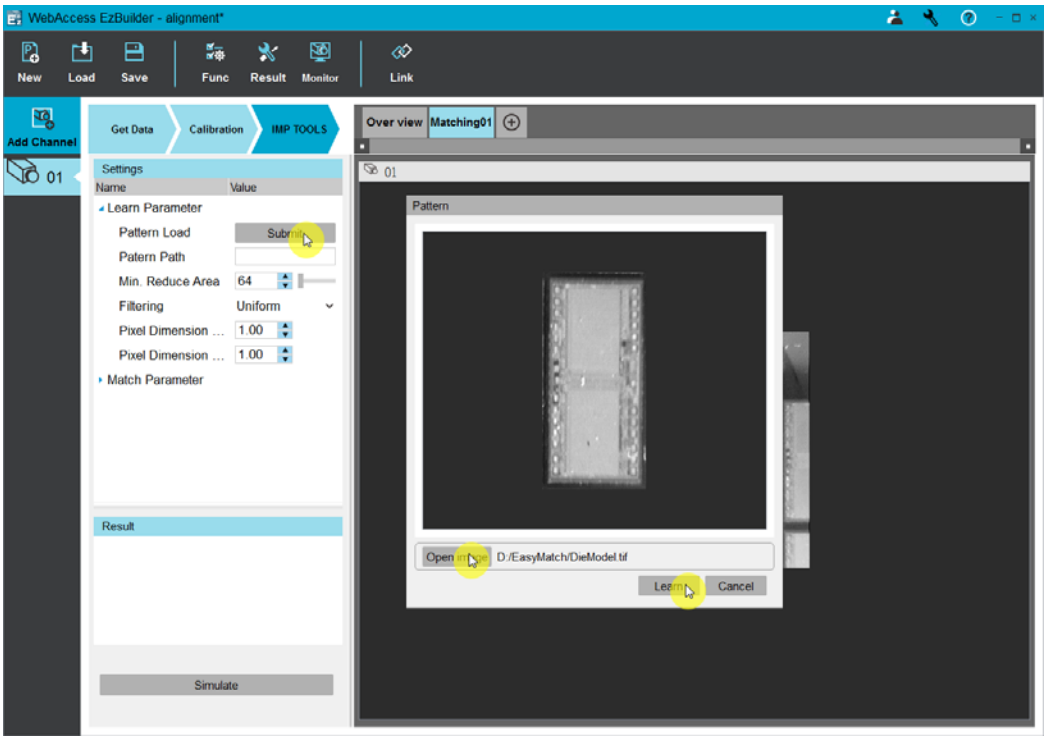
6. Click **Calibrate**. This will show a confirmation dialog box and generate a .Cal file. Click **OK** to proceed to the next step.



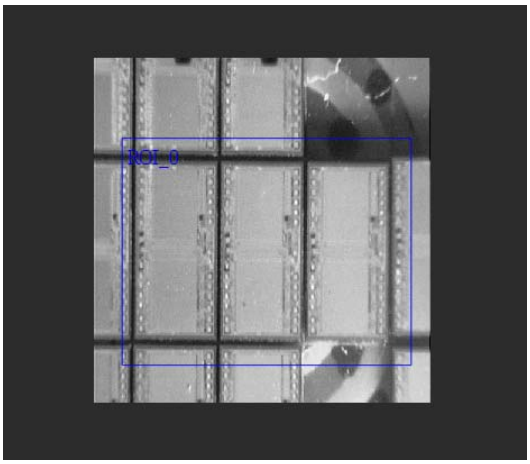
7. Click the **Add** icon ⊕ and select **Matching** in the **IMP Tools** dialog box.



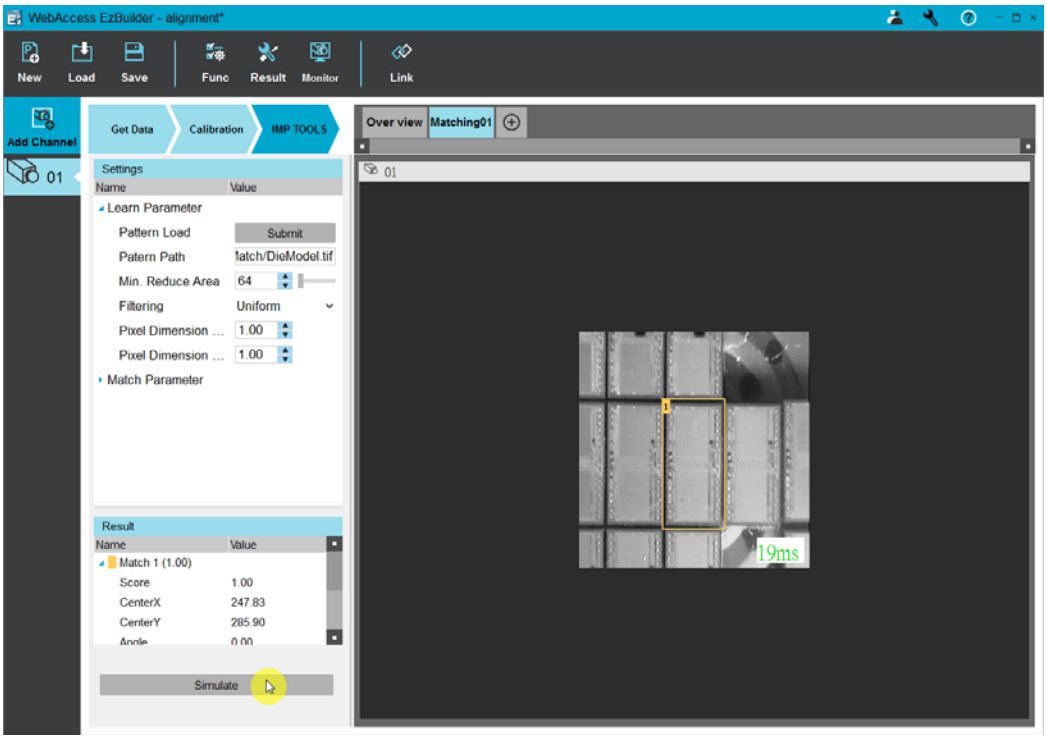
8. Click **Pattern Load** under **Settings** in the **IMP TOOLS** panel. In the **Pattern** dialog box, click **Open** Image to open the desired pattern image and then click **Learn**. This will close the **Pattern** dialog box.



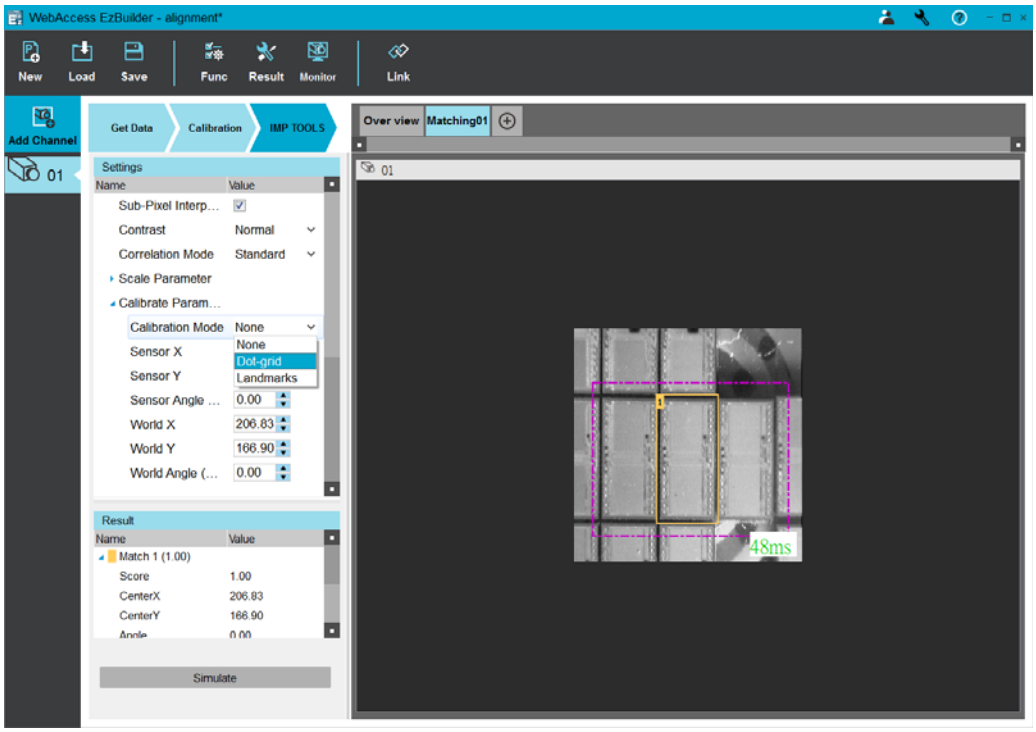
9. Right-click on the image and select **New ROI**. Drag the ROI corner and side handles to move the ROI to the required position.



10. Click **Simulate**. You will now be able to see the matching results.



11. You can select **Dot-grid** from the **Calibration** field under **Settings** in the **IMP TOOLS** panel.



ADVANTECH

Enabling an Intelligent Planet

www.advantech.com

Please verify specifications before quoting. This guide is intended for reference purposes only.

All product specifications are subject to change without notice.

No part of this publication may be reproduced in any form or by any means, electronic, photocopying, recording or otherwise, without prior written permission of the publisher.

All brand and product names are trademarks or registered trademarks of their respective companies.

© Advantech Co., Ltd. 2018