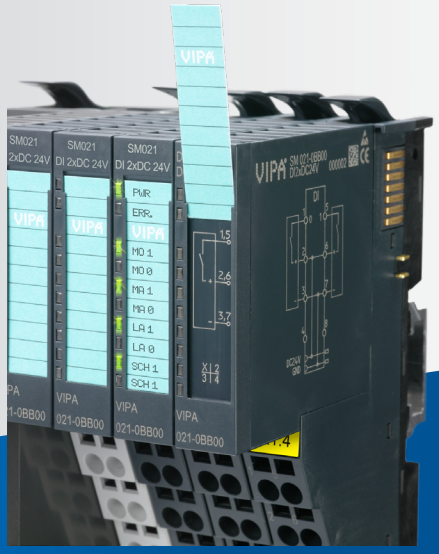
VIPA CONTROLS

VIPA SLIO Remote I/O

The remote I/O system, Yaskawa Smart Pendant & Yaskawa Robot Controller Tutorial



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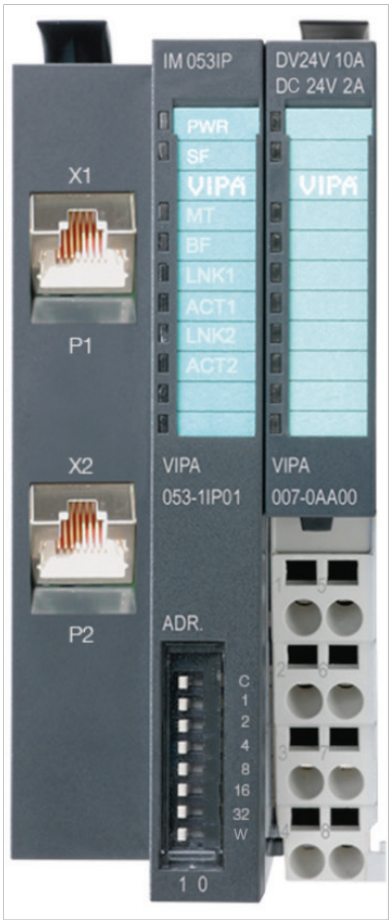
General Comments:

- Read the tutorial carefully before installation, operation maintenance, inspection, or troubleshooting.
- This tutorial does not replace the proper use of the manuals for each module and software.
- Please find SLIO manuals here: https://vipausa.com/pages/downloads/manuals.html.
- This tutorial is subject to change and recommendations for improvement are always appreciated – please contact support@vipausa.com with feedback.
- Any safety and legal comments of Yaskawa Europe GmbH can be found in each manual.

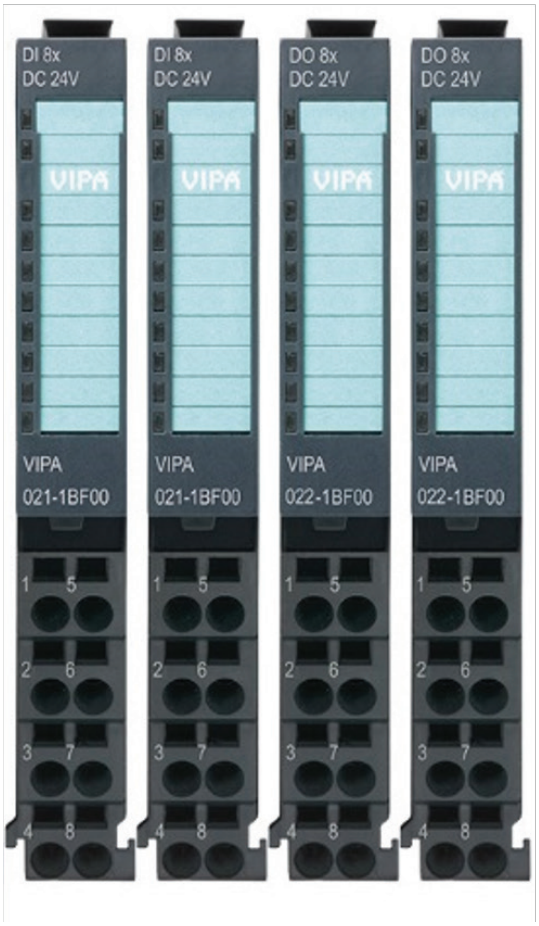
VIPA I/O Expansion Kit for Smart Series

This document describes how to configure and test a VIPA EtherNet/IP Coupler + Configurable SLIO Modules with the YRC1000 and YRC1000micro Controllers (collectively referred to as YRC Controller in this document). These instructions are valid for all types of SLIO modules; however, the exact configuration(s) covered in this document are outlined below:

EtherNet/IP Coupler Interface (053-1IP01)



Configurable SLIO Modules (Digital, Analog, etc.)



Kit Contents

Three VIPA I/O expansion kits are available for Yaskawa robot controllers:

16 IN, 16 OUT Digital I/O: Part # 099-1IP20

Includes:

- 1x SLIO 053-1IP01 / EtherNet/IP Interface Module
  - SLIO 007-0AA00 / Power Module (embedded with Interface Module)
- 2x SLIO 021-1BF00 / 8 Digital Inputs PNP
- 2x SLIO 022-1BF00 / 8 Digital Outputs PNP, 0.5A

8 DI, 8 DO, 8 AI, 4 AO Current I/O: Part # 099-1IP50

Includes:

- 1x SLIO 053-1IP01 / EtherNet/IP Interface Module
  - SLIO 007-0AA00 / Power Module (embedded with Interface Module)
- 1x SLIO 021-1BF00 / 8 Digital Inputs PNP
- 1x SLIO 022-1BF00 / 8 Digital Outputs PNP, 0.5A
- 1x SLIO 031-1BF60 / 8 Analog Inputs, 12Bits. 0/4...20mA
- 1x SLIO 032-1BD40 / 4 Analog Outputs 12Bits. 0/4...20mA

8 DI, 8 DO, 8 AI, 4 AO Voltage I/O: Part # 099-1IP90

Includes:

- 1x SLIO 053-1IP01 / EtherNet/IP Interface Module
  - SLIO 007-0AA00 / Power Module (embedded with Interface Module)
- 1x SLIO 021-1BF00 / 8 Digital Inputs PNP
- 1x SLIO 022-1BF00 / 8 Digital Outputs PNP, 0.5A
- 1x SLIO 031-1BF74 / 8 Analog Inputs, 12 Bits. +-10V
- 1x SLIO 032-1BD70 / 4 Analog Outputs, 12 Bits. +-10V

Custom Kit: Part number 099-1IP99

- Other variations are available upon request. Examples include NPN I/O, Analog I/O with current output, power distribution module for external devices, etc. Please contact sales@vipausa.com.

What's Not Included in the Kit

Customer must provide the following:

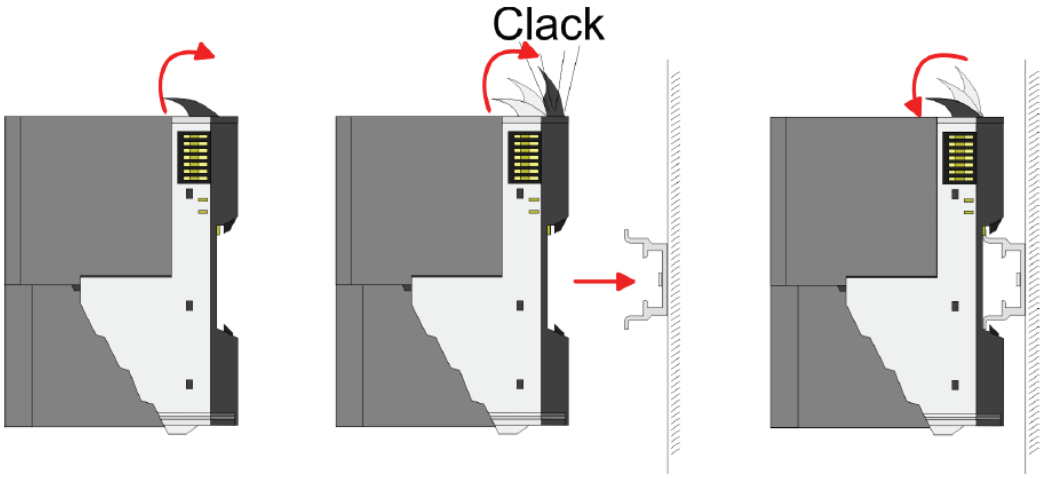
- 24VDC power supply (10A recommended)
- Mount hardware (e.g. DIN rail)
- Wiring hardware for power distribution and I/O
  - Terminated jumper wires
  - Screwdriver
- Cat5 (or higher) Ethernet cable of desired length

Setup for VIPA I/O Expansion Kit & Robot Controller

These instructions will be used to configure a VIPA I/O Expansion Kit on a Smart Series system.

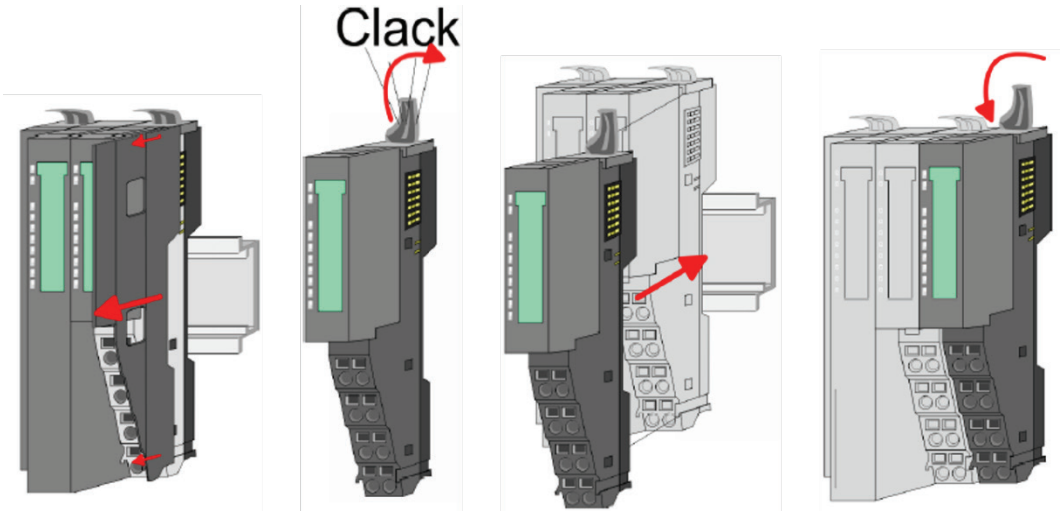
Mount VIPA Kit

1. To mount/demount the EtherNet/IP coupler, use the locking levers on top of the bus coupler. Turn the levers upwards until they engage. Next, mount the coupler on the DIN rail. Finally, secure the coupler to the DIN rail by pushing the locking levers downward.



2. Next, mount the periphery modules included in your kit. First, remove the cover on the right side of the bus coupler by pulling it forward.

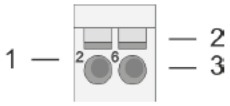
   Open the locking levers and slide each module in the slotted grooves as shown below. Once the module is in place (check grooves and DIN rail), use the locking lever to complete its mounting. Repeat for this process for all periphery modules.



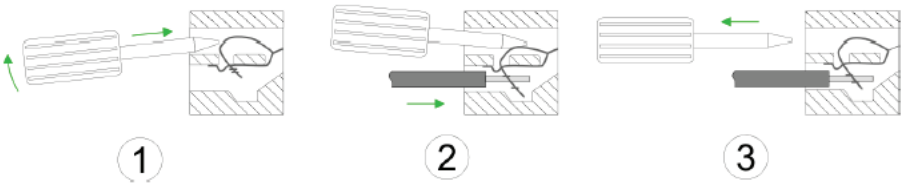
3. Once the entire kit is mounted, re-mount the cover removed in Step 1 to the end of the configuration to protect the backplane bus connectors.

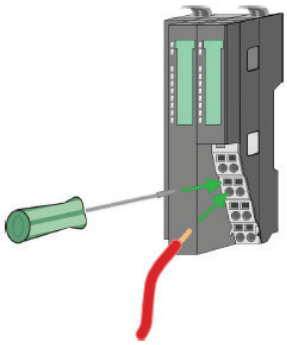
Power VIPA Kit

Terminals with spring clamp technology are used for wiring SLIO modules. This vibration proof technology allows for quick and easy connection of your signal and supply lines.



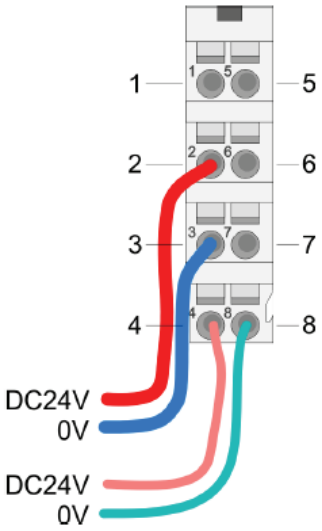
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire





1. Insert a screwdriver at an angle into the square opening as shown above. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. Use wires with cross section 0.08 to 1.5mm^2
3. By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

Use the following diagram to connect power to the EtherNet/IP bus coupler.



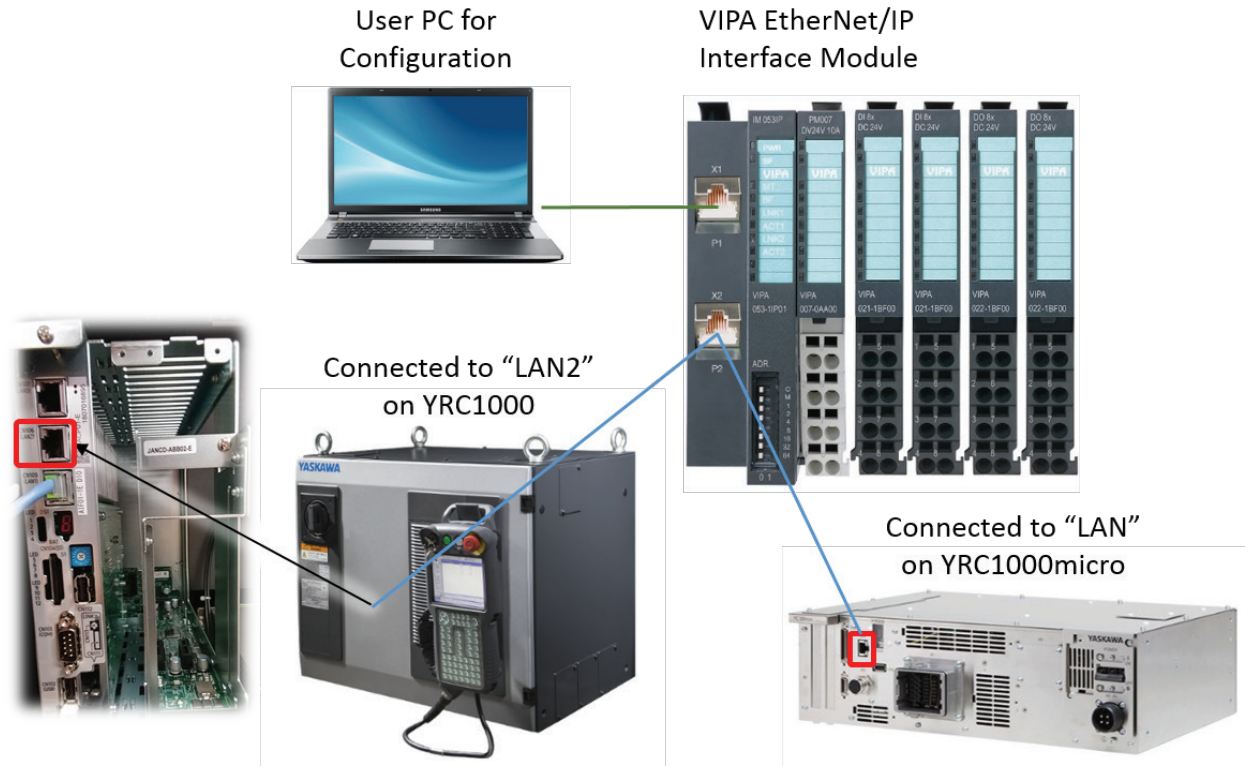
Pos.	Function	Type	Description
1	---	---	not connected
2	DC 24V	I	DC 24V for power section supply
3	0V	I	GND for power section supply
4	Sys DC 24V	I	DC 24V for electronic section supply
5	---	---	not connected
6	DC 24V	I	DC 24V for power section supply
7	0V	I	GND for power section supply
8	Sys 0V	I	GND for electronic section supply

I: Input

Note: For most applications, terminals 2 & 4 above will be connected to the same terminals from the external power supply. The same applies for terminals 3 & 8.

Network Configuration

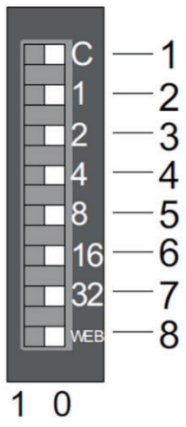
The VIPA expansion kit should be connected to the YRC controller through one of the Ethernet ports on 053-1IP01. A PC can also be connected to configure the VIPA kit using its web server. See network configurations for both the YRC1000micro and YRC1000 controllers below:



Configure VIPA IP Address

The IP address of the EtherNet/IP bus coupler is determined by physical "address switches". On delivery, all switches are in the "0" position and the factory default settings are:

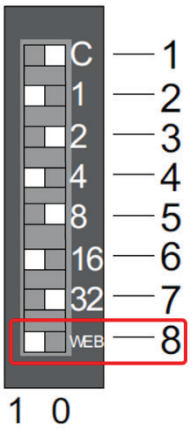
- IP address: 192.168.1.2
- Subnet mask: 255.255.255.0



Pos.	Label	Description
1	C	■ 0 = DHCP off ■ 1 = DHCP on 4. Octet (x) of the IP address 192.168.1.x (max. value for x = 31)
2	1	$2^0 = 1$
3	2	$2^1 = 2$
4	4	$2^2 = 4$
5	8	$2^3 = 8$
6	16	$2^4 = 16$
7	32	$2^5 = 32$
8	WEB	■ 0 = Web server is disabled ■ 1 = Web server is enabled

If the default address “192.168.1.2” is not available (i.e. conflicting with another device with this address), the fourth octet of the IP Address can be changed using the address switches on the Interface Module. For example, turning switches 2, 4, & 6 to ON would change the address to “192.168.1.21” (i.e. 1+4+16). See the switch positions in the figure below:

VIPA Web Server

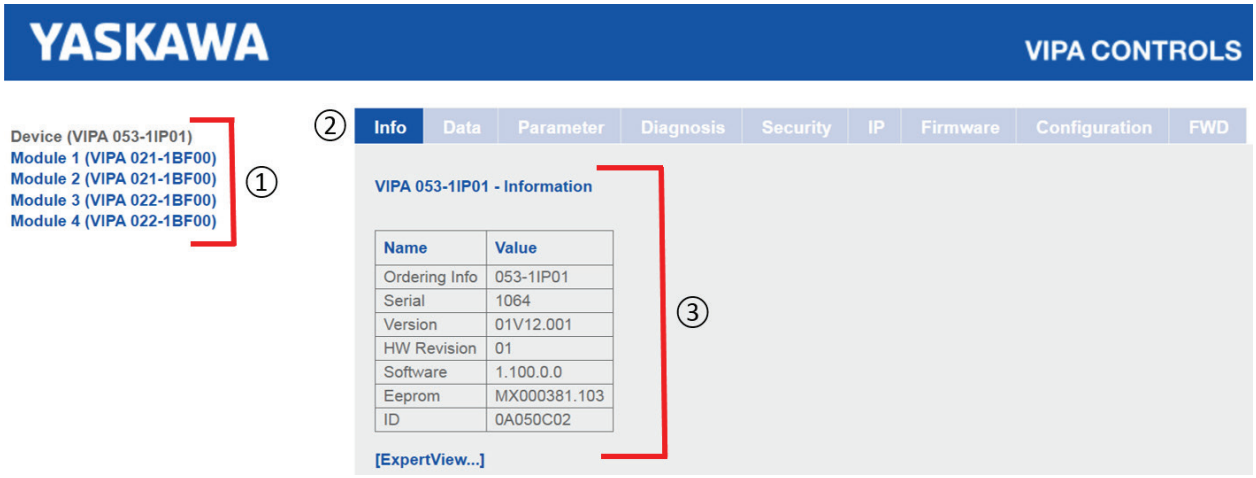


To access the VIPA web server, address switch 8 labeled **“WEB”** must be switched to the “1” position to enable its functionality. Also, a PC must be connected via a networking cable (see previous section).

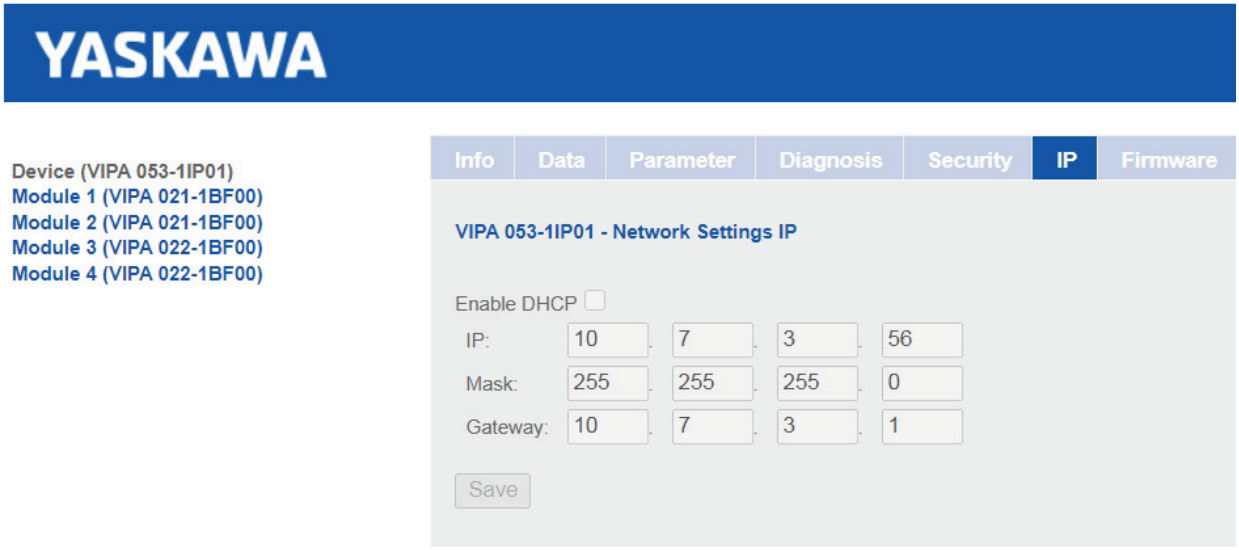
The web server can be opened from any browser. The server is built dynamically and will display the number of modules connected to the EtherNet/IP coupler.

The web server can be broken into the following 3 categories:

1. Module list: EtherNet/IP coupler and system SLIO modules listed in order of installation
2. Tab bar with available functions for the module selected in 1)
3. Information corresponding to the tab selected in 2)



If the VIPA kit needs to be configured on a network outside of 192.168.1.x, this can be changed from the **IP tab** of the web server. For example, the following figure shows changing the IP Address to “10.7.3.56”.



Note: after editing the IP address, physical address switches 1 to 7 must be reset to "0" to avoid overwriting the IP address entered in the web server.

Ping both the VIPA kit and the YRC Controller from a PC to verify communication has been established using the custom IP configuration.

Additional information about other functions supported by the web server is available in the manual 053-1IP01 (Chapter 4.5 Web server).

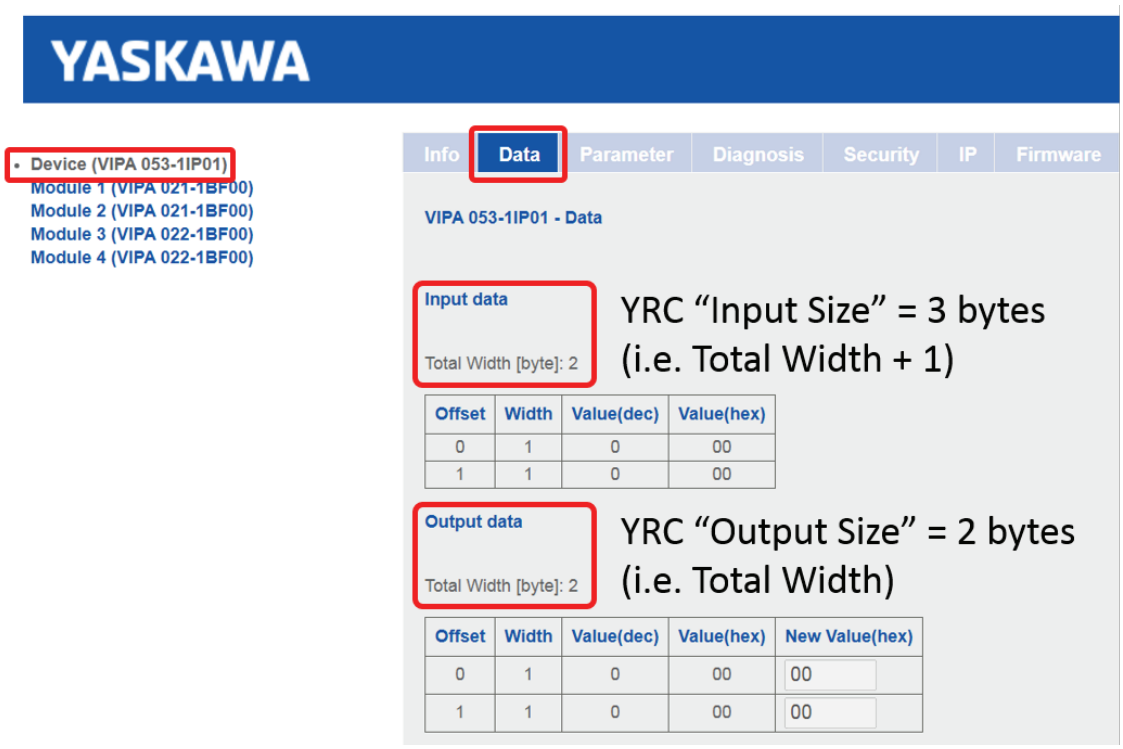
Configure Yaskawa Robot Controller

This section provides the steps require to configure the YRC Controller for successful communication with a VIPA Smart Series I/O kit. VIPA 099-1IP20 is used as an example in this guide - similar steps should be followed for other VIPA kits.

1. **Determine configuration of VIPA kit using web server**

   Use the VIPA web server to determine EtherNet/IP information required by the YRC controller.

   Connect to the web server by entering its IP Address into a web browser on the same network as the device (e.g. “http://192.168.1.2”). Verify “Total Width” for Input and Output data by selecting the Interface Module “Device” at the top of the tree on the left and navigating to the “Data” tab shown below.

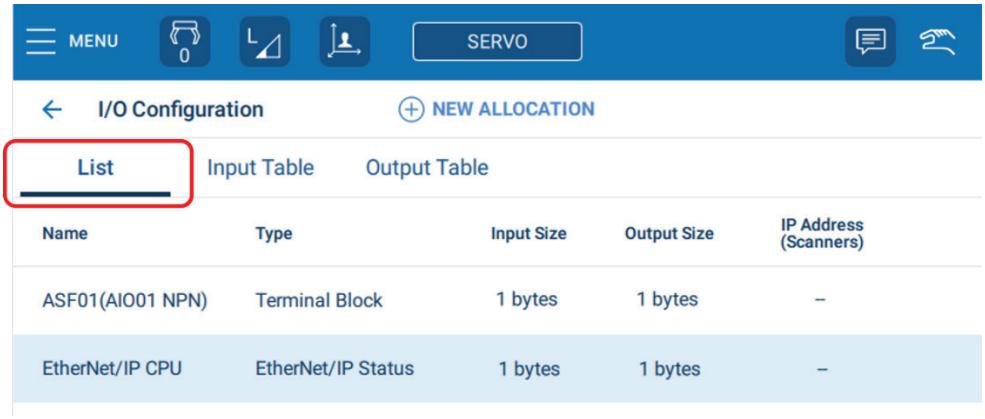


   For VIPA 099-1IP20, both the **Input Size** and **Output Size** read 2 bytes. These values will be used to populate EtherNet/IP settings in the YRC Controller.

   Note: 1 byte must be added to the “Input Total Width” reported by the web server for communication between the VIPA kit and YRC controller to work properly.

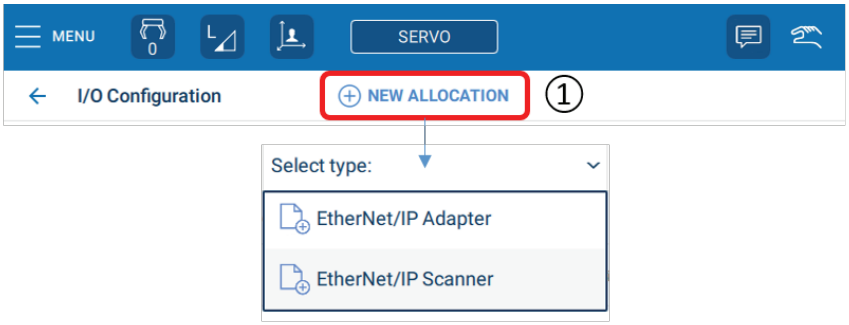
2. **Open I/O Configuration screen on Smart Pendant**

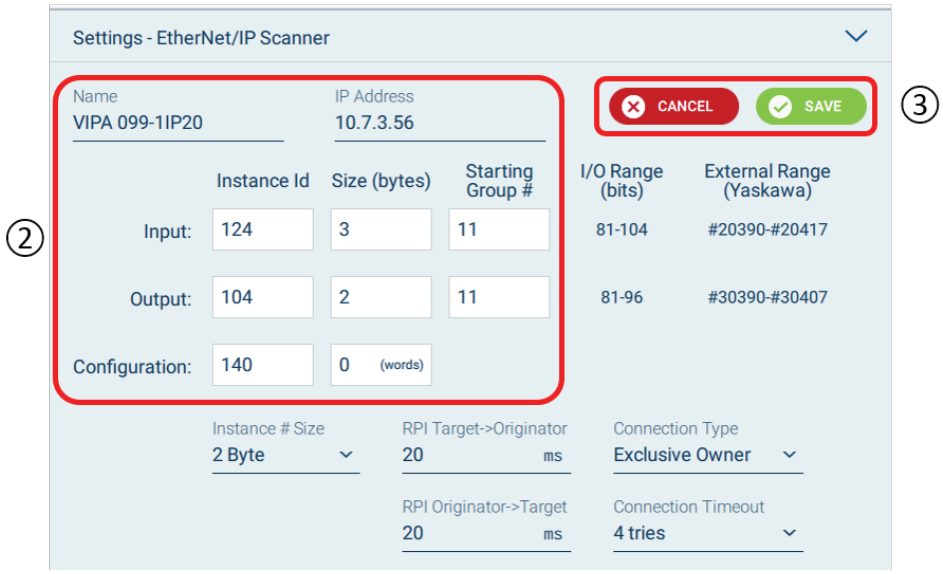
   On Smart Pendant, use the **List Tab** on the {Menu} > {System Settings} > {I/O Configuration} screen to view a list of configured devices on the robot controller and/or add a new device. Selecting a device will display its details on the bottom panel.



3. **Create a "New Allocation" for VIPA with data from web server**

   1) Press {+ New Allocation} at the top of the I/O Configuration Screen. Select "EtherNet/IP Scanner" from the drop-down menu. Manual (Teach) mode and Management Security Level are required.





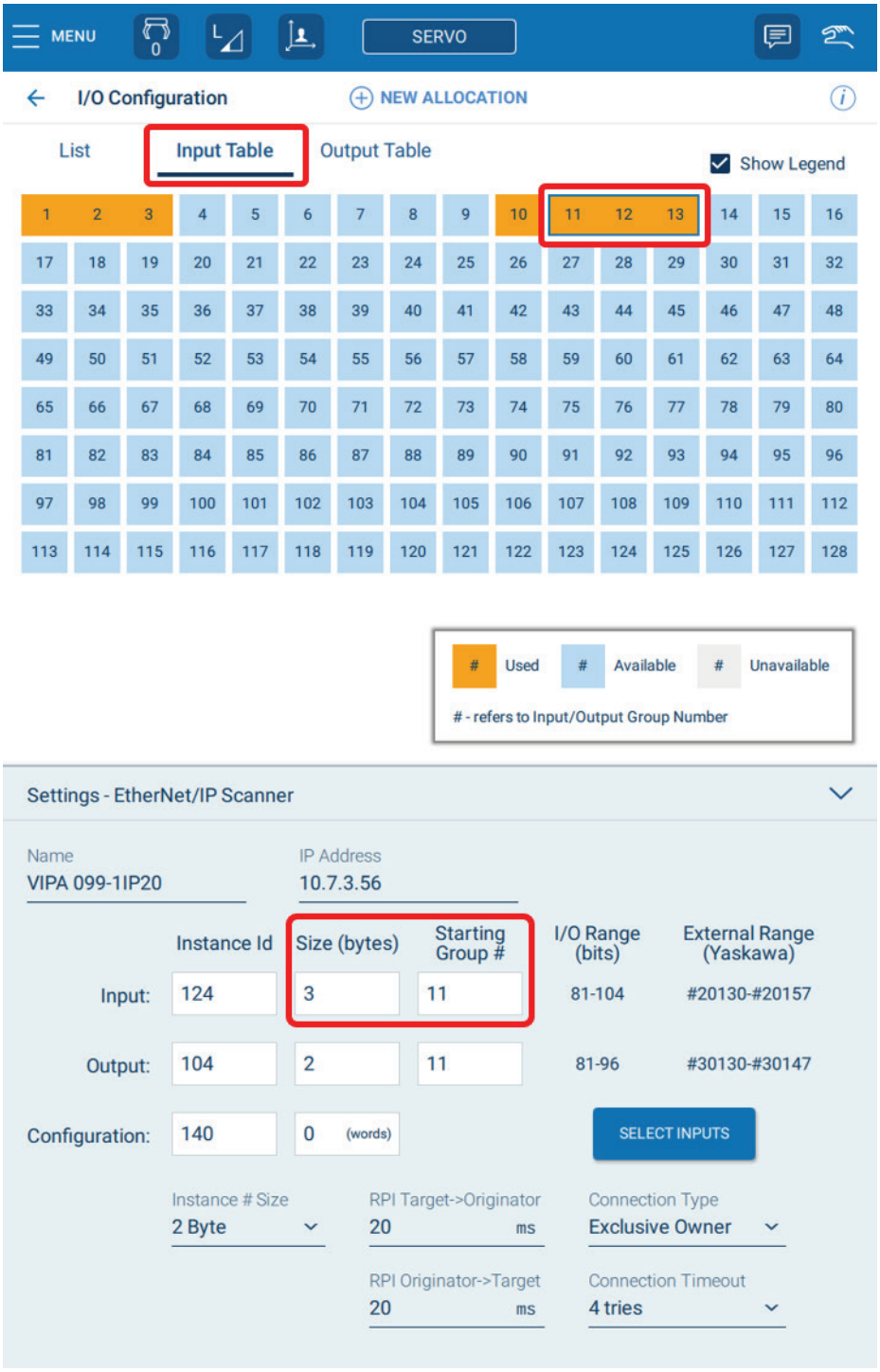
2) Data entry for VIPA kit on the lower detail panel.
    i. Enter the **IP Address** of the VIPA kit defined previously and enter a name (i.e. VIPA 099-1IP20)
    ii. Enter **Input Size** and **Output Size** determined in Step #1
        - Input Size = 3 bytes
        - Output Size = 2 bytes
    iii. Enter **Instance IDs** for the VIPA kit
        - Input ID = 124
        - Output ID = 104
        - Configuration ID = 140
3) After entering all data above, carefully review and press **{Save}**

Note: Default Instance IDs in the official VIPA documentation use Input = 120 and Output = 100. However, these values only work if the Input and Output sizes are set to 496 bytes – much too large for the YRC1000micro controller. Using Input=124 / Output=104 allows for dynamic sizing, correlating to the sizes shown on the web server found in Step #1.

4. **Review (and edit) location of VIPA allocation**

In Step #3, the Starting Group #'s were automatically set to the first available range of bytes in each respective table. If a custom location is desired, the **Input Table** and **Output Table** tabs can be used to edit where I/O dedicated for the VIPA kit lands on the controller.

These tables provide a visual representation of allocated Inputs and Outputs on the robot controller. Find the orange (i.e. "Used) range of bytes allocated for the VIPA kit to view their Input and/or Output allocations. If desired, the user can edit the **Starting Group #** directly or use the **{Select Inputs}** button to change its location (light blue squares represent areas of available space, see the legend for more details).

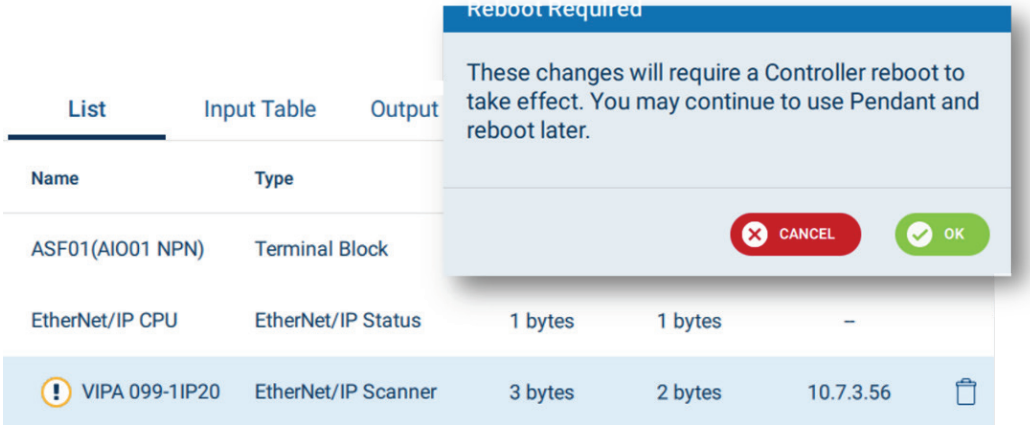


Yaskawa recommends placing the allocation for the VIPA kit near the EtherNet/IP Status byte. In the example shown above, the EtherNet Status byte is located at Group 10 and the VIPA allocation begins in Group 11. Additionally, **"Starting Group #"** for Inputs and Outputs should match (both set to 11 above).

If “Size (bytes)” or “Starting Group #” are modified, Smart Pendant will check whether the edit(s) conflict with any other devices. As shown below, a message will appear if conflict(s) exist, preventing the user from pressing **{Save}** until they are resolved.

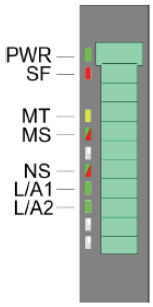
5. **Reboot robot controller to activate new configuration**

   In Steps #3 and #4, new data was entered/edited for the VIPA I/O kit and saved by the user. When the edited data is saved, a message will appear alerting the user to reboot the controller to activate the new devices configuration. Modified device(s) will also have an icon next to it in the list:



6. **Confirm communication between YRC controller and VIPA kit**

   The “MS” LED on the VIPA EtherNet/IP Interface Module should be solid green if communication has successfully been established. The following table shows the meanings of the various status bits:

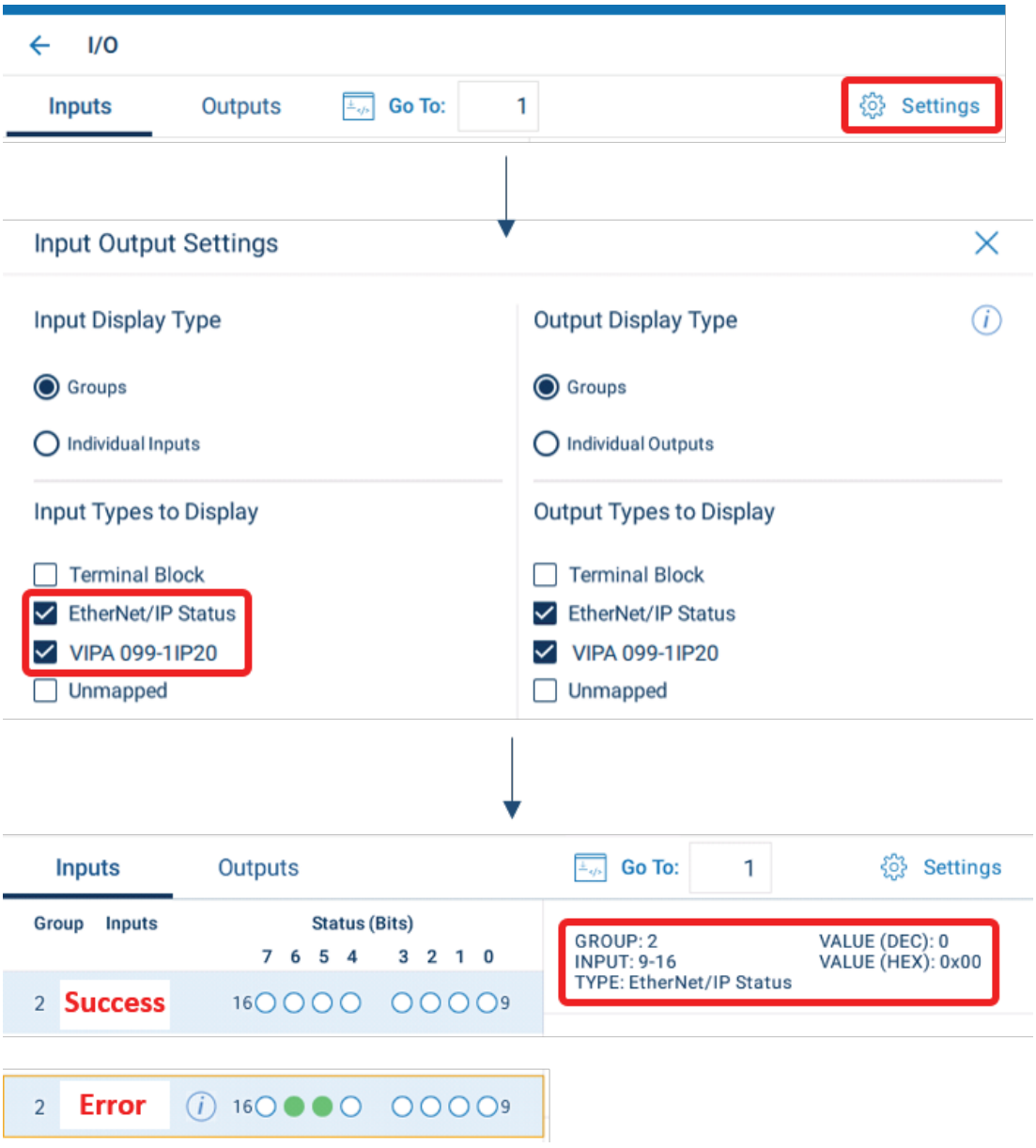


LED	Color	Description
PWR	green	The EtherNet/IP coupler is power supplied.
SF	red	Operating mode *Error* mode. Error on Ethernet or System SLIO bus. Please perform a power cycle!
	red 2Hz	Operating mode *Error* mode. Unrecoverable error. Please contact our support.
MT	yellow	■ Operating mode *Commissioning* mode ■ Maintenance
	yellow 2Hz	■ A firmware update is in progress. Here the SF and MT LEDs blink alternately. ■ DHCP Request ongoing
MS	green	Operating mode *Operational* mode.
	green 2Hz	Operating mode *Idle* mode.
	red	Unrecoverable module error. If after a power cycle the error still exists persists, please contact our support.
	red 2Hz	Recoverable module error (e.g. error in the configuration).
	green/red	Start-up self-test (1 x blinking: green, red).
NS	green	Network status: EtherNet/IP communication: RUN.
	green 2Hz	There is no connection to a scanner.
	red 2Hz	Recoverable EtherNet/IP error.
	green/red	Start-up self-test (1 x blinking: green, red).
L/A1/2	green	Network activity (port 1 / port 2)

Additionally, the EtherNet/IP Status byte on Smart Pendant can be used to diagnose communication. Navigate to {Menu} > {I/O & Variables} > {I/O} screen.

Use the **{Settings}** button on the I/O screen to ensure the EtherNet/IP Status byte is visible. Next, find the Input Group in the I/O list that reads "**TYPE: EtherNet/IP Status**" in the right panel.

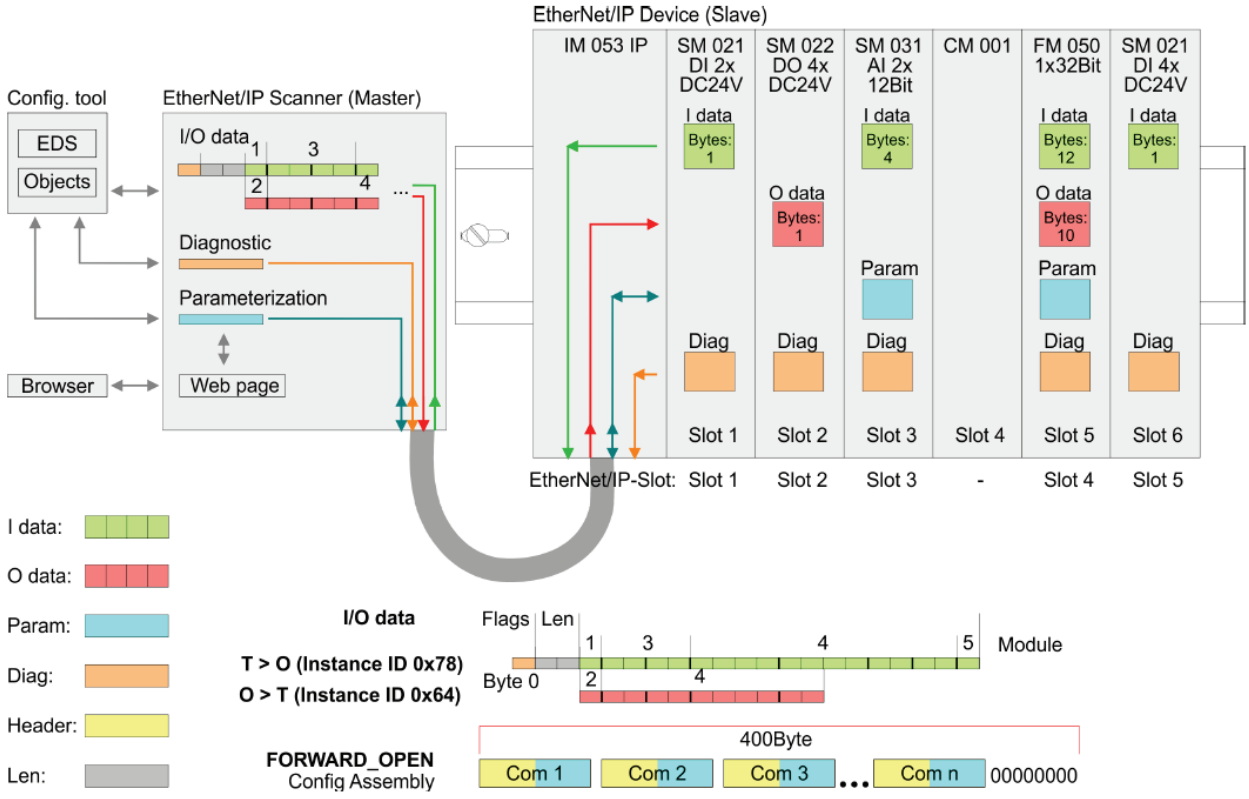
This byte should read **"0"** if communication has been established and is operating without error. Otherwise, this byte will be highlighted in yellow with a **{Help}** button as shown below.



VIPA I/O Expansion Kit Details

Data Layout

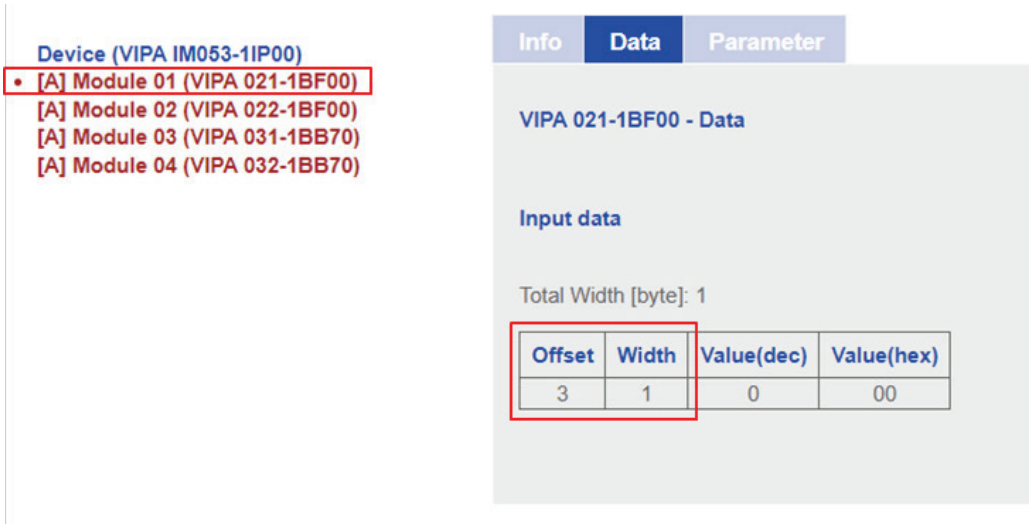
The data in the EtherNet/IP communications packet will automatically populate according to the physical configuration of the devices in the rack. For example, see the example shown below:



First, a 3-byte buffer is present before the start of Input data (green). Next, Slot 1 contains 1 byte of Input Data and thus will be the first byte of Input data following the 3-byte header. The next device with Input Data is in Slot 3 and accounts for the next 4 bytes of Input Data, etc.

VIPA I/O Expansion Kit Details

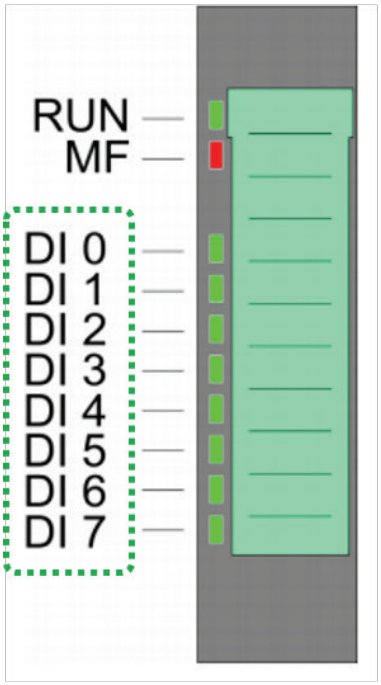
The web server can also be used to easily identify where the data for a specific device is located. For example, below shows the data for an Input Module. The “Offset” value is the location from the start of the Input Data. For example, if the data is mapped to Input Group #5 as shown in this example, then this data will be located at Input Group #8 (3+5) and will take 1 byte of data.

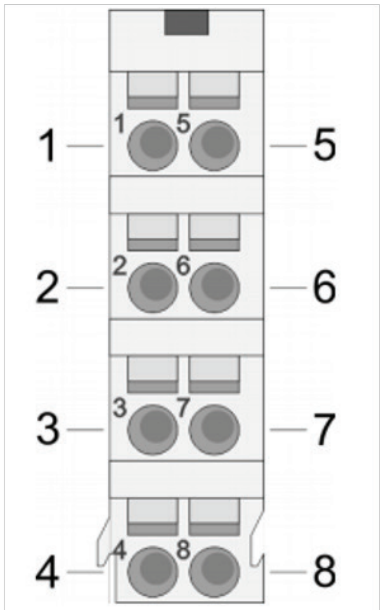


Using Digital I/O Modules

The following sections provide detail on the wiring, Smart Pendant setup, and Smart Pendant programming methods for VIPA **Digital I/O** modules.

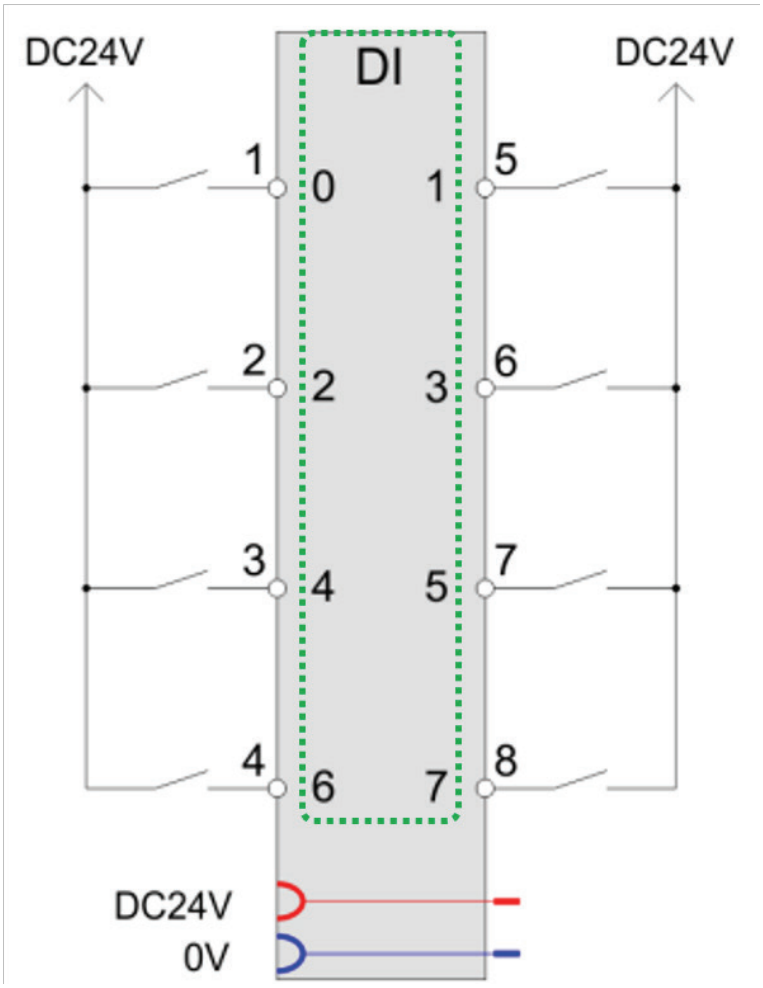
Wiring Detail for PNP Digital Inputs (021-1BF00)



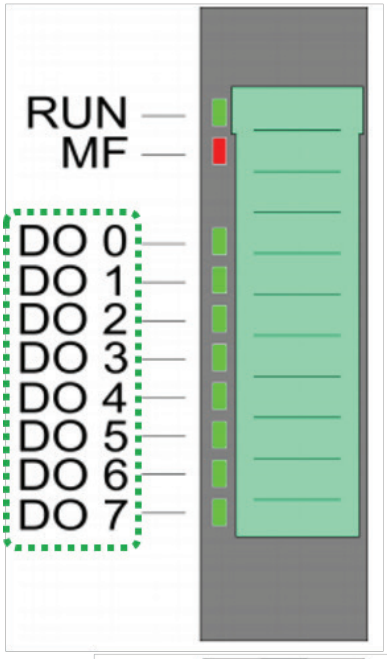


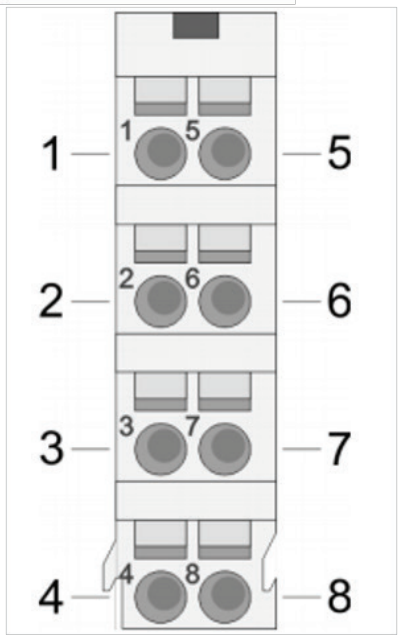
Pay close attention to
"input number (DI)" vs "pin assignment"

Use wires with a cross
section of 0.08 to 1.5mm^2



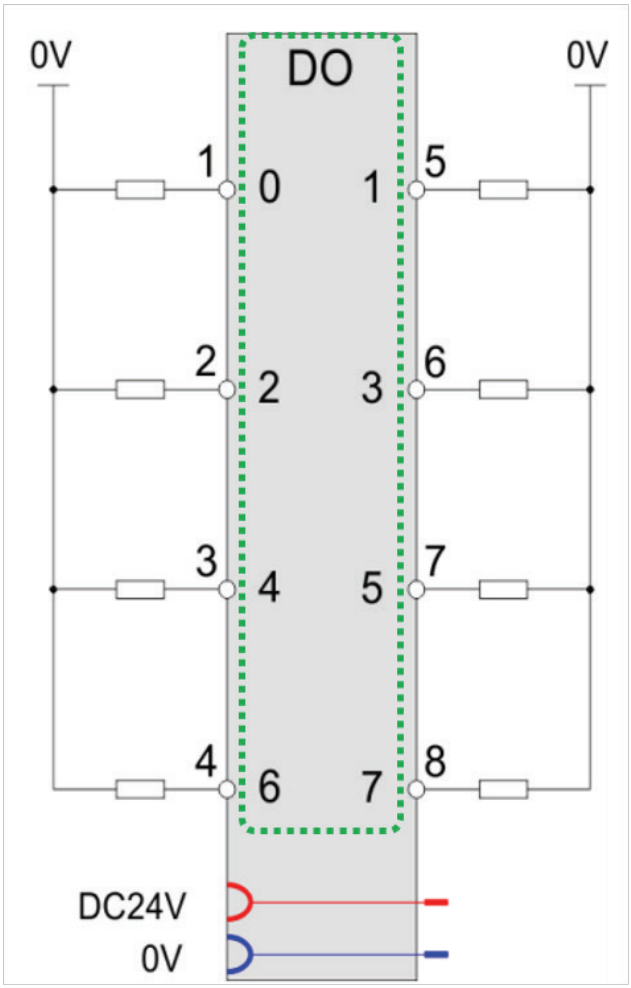
Wiring Detail for PNP Digital Outputs (022-1BF00)





Pay close attention to
"output number (DO)" vs "pin assignment"

Use wires with a cross section of 0.08 to 1.5mm^2



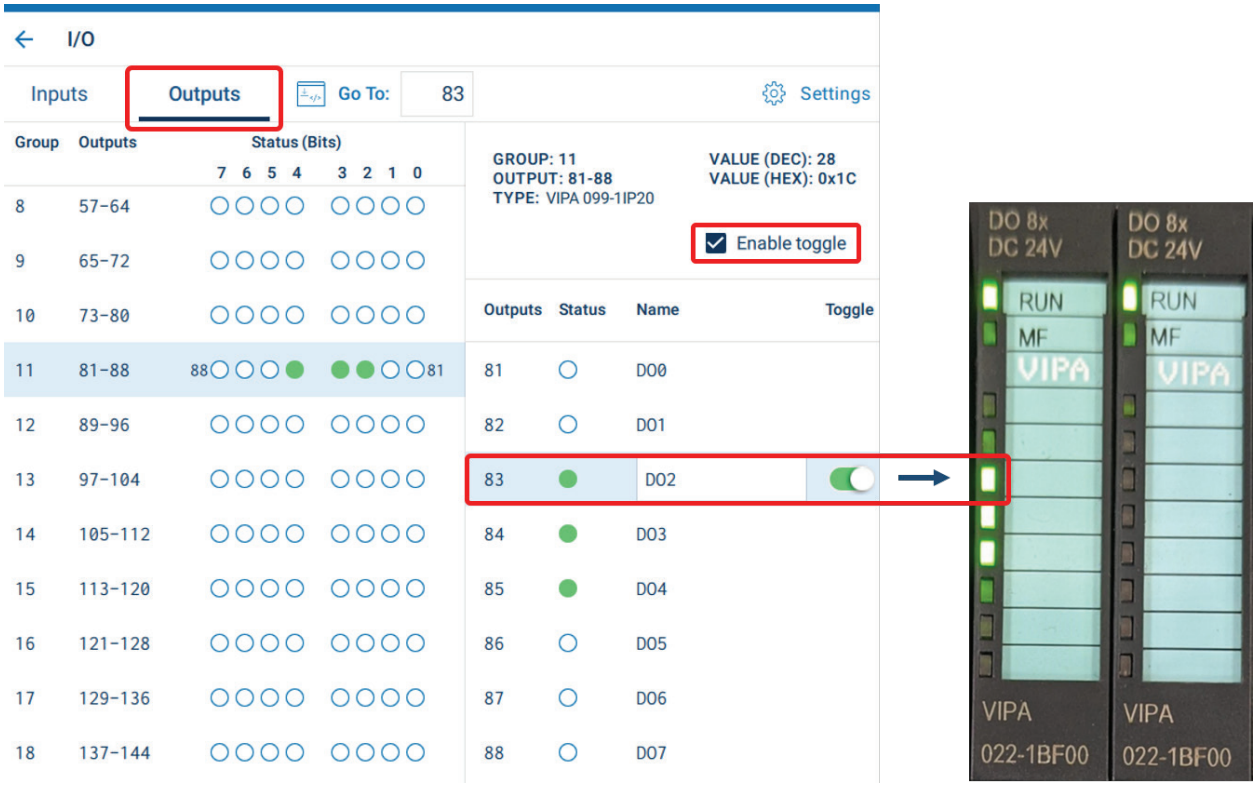
CAUTION!
Feeding in voltage at an output is not allowed and can destroy the module!

Digital I/O on Smart Pendant

Setup & Monitoring

To view Digital Input and Output status on Smart Pendant, navigate to the I/O screen (Menu > I/O & Variables > I/O). Groups (i.e. bytes) are shown on the left panel and individual bits are shown on the right. Use the tab bar at the top to switch between **"Inputs"** and **"Outputs".**

In Teach Mode, Digital Outputs can be toggled. Activate the **"Enable toggle"** checkbox in Management security level. Output bits can be selected on right panel to turn ON/OFF. Green lights on VIPA SLIO module will indicate whether the Output is ON / OFF.



Programming

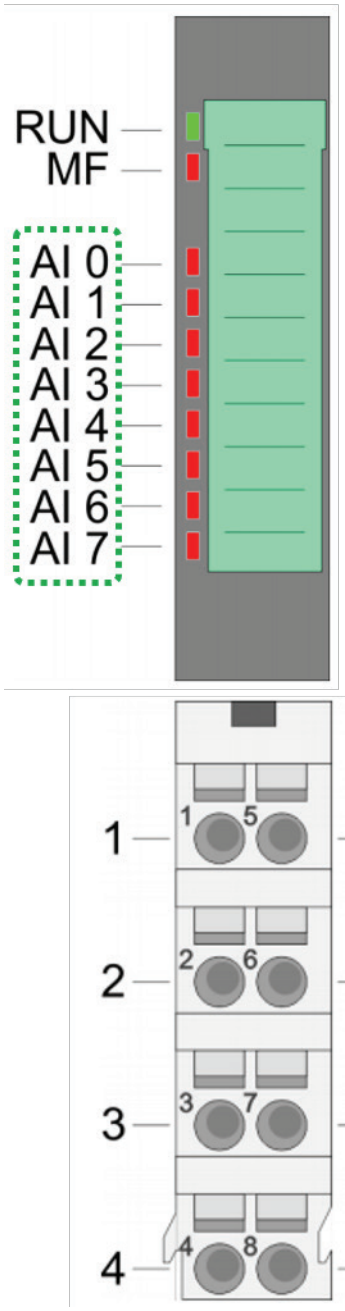
Smart Pendant provides several I/O related INFORM **"Commands"** to programmatically read and write Digital I/O from the VIPA kit. Example commands are shown below:

```
 9 DigitalIn  B001  Input#( DI3 )

10 Wait  Input#( DI6 )  =    On

11 DigitalOut  Output#( DO2 )  On
```

Using Analog I/O Modules

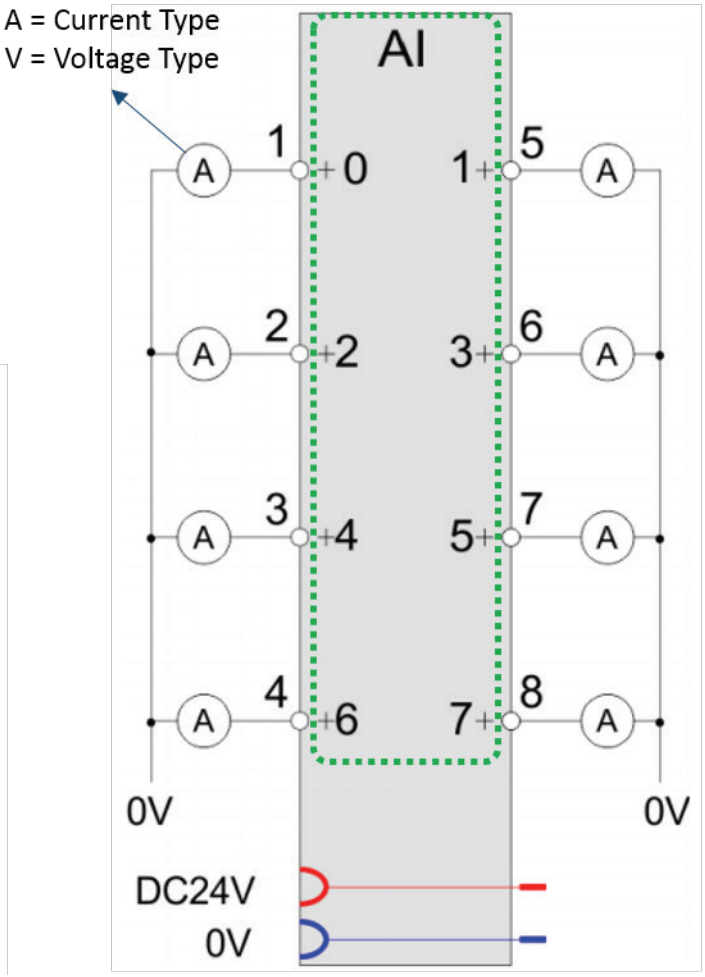
The following sections provide detail on the wiring and Smart Pendant programming methods for VIPA **Analog I/O** modules.

Wiring Detail for Analog Inputs (Current: 031-1BF60, Voltage: 031-1BF74)

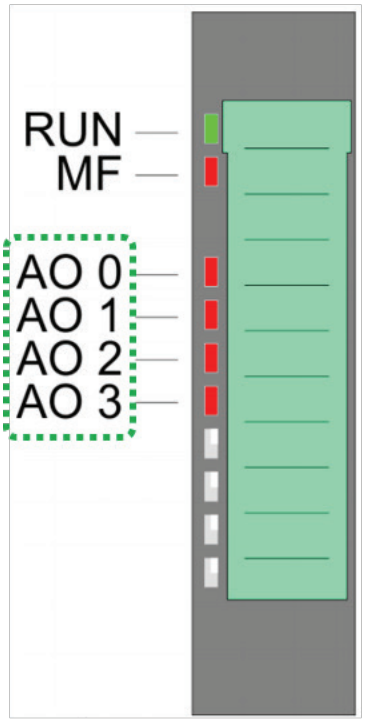


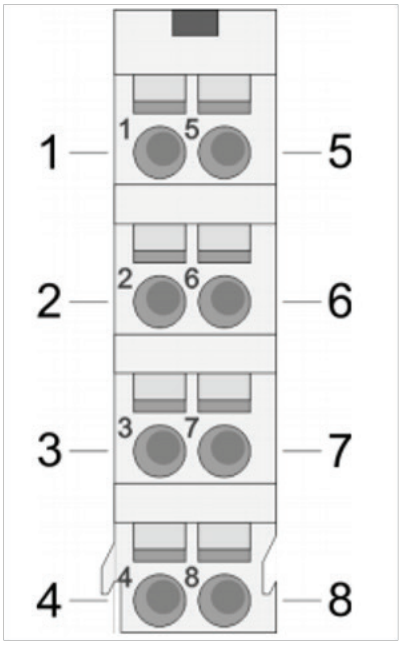
Pay close attention to
"input number (AI)" vs "pin assignment"

Use wires with a cross section of 0.08 to 1.5mm^2



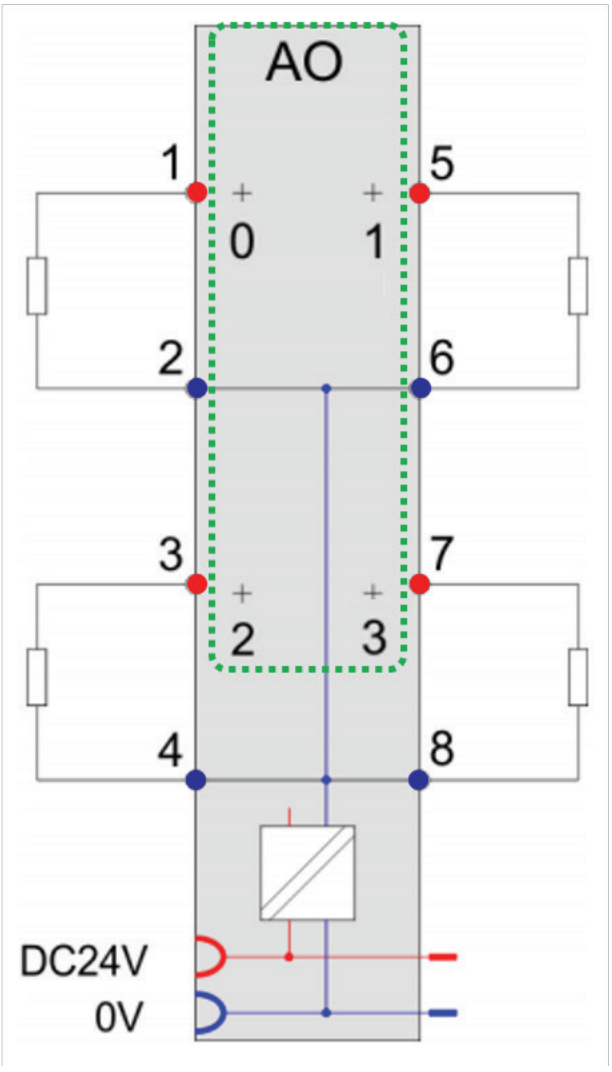
Wiring Detail for Analog Outputs (Current: 032-1BD40, Voltage: 032-1BD70)





Pay close attention to
"output number (AO)" vs "pin assignment"

Use wires with a cross section of 0.08 to 1.5mm²



Analog I/O on Smart Pendant

VIPA Analog I/O modules have a variety of configurations as shown below. The device used in this example uses the 12-bit configuration from this table.

Resolution	Analog value															
	High byte (byte 0)								Low byte (byte 1)							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	SG	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
12Bit	SG	Measuring value												0	0	0
15Bit	SG	Measuring value														

As discussed earlier, the first Analog Output is mapped to Output Group #6-7 for this example. Therefore, the data has the following layout:

OUT#56	OUT#55	OUT#54	OUT#53	OUT#52	OUT#51	OUT#50	OUT#49
#10077	#10076	#10075	#10074	#10073	#10072	#10071	#10070
SIGN	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}

OUT#48	OUT#47	OUT#46	OUT#45	OUT#44	OUT#43	OUT#42	OUT#41
#10067	#10066	#10065	#10064	#10063	#10062	#10061	#10060
2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	X	X	X

The procedure for setting an Analog Output (voltage type) is:

1. Select desired Voltage
2. Convert Voltage into decimal value (e.g. *decimal* = 27648**voltage*/10)

   For example, to output 5.5V: decimal = 27648*5.5/10 = 15206

   The binary representation of 15206 is: 00111011 01100110
3. Assign the decimal values to Output Group #6-7 using the layout shown above.

The desired voltage can now be measured from the device. An example job to perform this operation is included below.

Example Smart Pendant Job for setting Analog Output(s)

```
/JOB
//NAME SETVOLTAGE
//POS
 ///NPOS 0,0,0,0,0,0
//ARGINFO
///ARGTYPE B,,,,,,,
///COMMENT
Voltage

//INST
///DATE 2019/10/31 00:21
///ATTR SC,RW
///GROUP1 RB1
///LVARS 5,0,10,10,0,0,0,0
NOP
GETARG LR000 IARG#(1)
SET LD000 0
ADD LD000 LR000
IFTHENEXP LD000<0
      SET LD001 32768
ELSE
      SET LD001 0
ENDIF
SET LR001 LR000
DIV LR001 10
MUL LR001 27648
ADD LD001 LR001
SET LD002 LD001
DIV LD002 256
MUL LD002 256
SET LD003 LD001
SUB LD003 LD002
SET LB000 LD003
DIV LD001 256
SET LB001 LD001
DOUT OG#(6) LB000  // Edit OG#(6) to match your setup configuration
DOUT OG#(7) LB001  // Edit OG#(7) to match your setup configuration
END
```

Replacement of EtherNet/IP 053-1IP00 by 053-1IP01

If replacing EtherNet/IP coupler 053-1IP00 (previous model) with 053-1IP01, adjustments to the Input and Output assemblies **are required**.

Following the setup instructions in this guide will successfully perform these adjustments. Reference the figure below for further detail on the differences between the two couplers, required instance IDs, and the structure of the 1-byte Input header.

Description	053-1IP00	053-1IP01
Device profile	0x2B	0x0C
Output assembly		
Fixed size	0x0A - 0x13	0x64 - 0x67
Dynamic size	0x32 - 0x3B	0x68 - 0x6B
Input assembly		
Fixed size	0x14 - 0x1D	0x78 - 0x7B
Dynamic size	0x3C - 0x45	0x7C - 0x7F

Interrupt and diagnostics flags

An interrupt is pending when the corresponding bit is set.

- Bit 0: Process alarm
- Bit 1: Diagnostic alarm
- Bit 2: BASP
- Bit 3: Maintenance
- Bit 7 ... 4: reserved

Instance ID 0x7C (124) ... 0x7F (127) - Input values; dynamic size - T→O

Offset	Type	Content
0	BYTE	Header
1	ARRAY of BYTE	Input values; dynamic size (inputs) - input assembly (T→O

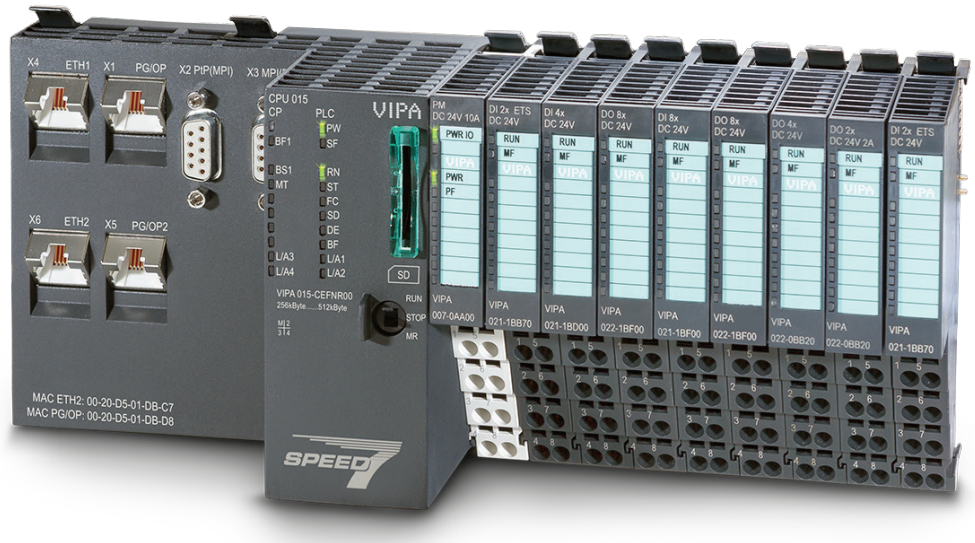
Instance ID 0x68 (104) ... 0x6B (107) - Output values; dynamic size - O→T

Offset	Type	Content
0	ARRAY of BYTE	Output values; dynamic size (Outputs) - output assembly

Instance ID 0x8C (140) - Config (400byte)

Offset	Type	Content
0	ARRAY of BYTE	Configuration ForwardOpen 76

VIPA SLIO Product Line



Use the following links to find more details on available SLIO products & configurations:

>> SLIO At-A-Glance: https://vipausa.com/slio-at-a-glance/

- SLIO Overview: https://vipausa.com/slio/
- CPUs: https://vipausa.com/cpu/
- Clamp Modules: https://vipausa.com/power-terminal-modules/
- Power Supply: https://vipausa.com/power-terminal-modules/
- Digital Input: https://vipausa.com/digital-inputs/
- Digital Output: https://vipausa.com/digital-outputs/
- Analog Input: https://vipausa.com/analog-inputs/
- Analog Output: https://vipausa.com/analog-outputs/
- Communication: https://vipausa.com/communication-processors/
- Function Modules: https://vipausa.com/function-modules/
- Interface Modules: https://vipausa.com/interface-modules/
- Accessories: https://vipausa.com/accessories-29/

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