



Application Note #5484

Interfacing Pro-Face AGP-3600T HMI with Galil RIO-47120 via Modbus TCP/IP

Introduction

In the factory automation industry, and many other industries, low cost programmable logic controllers (PLC) are used to address the IO requirements in a given system. Galil's new RIO family of PLC's offer a great solution for these types of systems. One of the powerful features of the RIO is the ability to run in a mode where the RIO performs certain tasks based on input from a user interface. Any human user interface (HMI) that can communicate via Modbus TCP/IP or that can send and receive ASCII strings can be used to provide input to the RIO. This application note will discuss using a Pro-Face AGP-3600T HMI to send and receive information from a RIO-47120¹.

Materials

- Pro-Face AGP-3600T HMI
 - Galil RIO-47120
 - Ethernet hub and 3 Ethernet Cables
 - PC with Pro-Face GP-Pro Ex and GalilTools software
- (PC, hub, and 3 Ethernet cables are only needed for setup and testing. Final system can run with 1 Ethernet cable between the HMI and RIO)

RIO Set Up

Begin by installing the GalilTools software on your PC. This can be downloaded for free from <http://www.galilmc.com/support/software-downloads.php> Connect the PC, the RIO, and the Pro-Face HMI via Ethernet cables to your hub or router and apply power to the RIO and HMI. Start the GalilTools software and choose the "No IP Address" tab. After several seconds the RIO should appear and you can choose an IP address and click assign. In our example the IP address will be 192.168.1.47. After you click assign, move to the "Available" tab and double click on the RIO. Once connected, in the terminal issue the command MV1 and press return. This command changes how the controller responds to Modbus function codes 3 and 4. Now issue the command BN to burn this parameter in.

```
Terminal
192.168.1.47, RIO47100 Rev 1.0b,
278, IHA
MU1
: BN
:
```

¹ Any member of the RIO family could be substituted

Pro-Face HMI Set Up

Begin by powering up the HMI and assigning an IP address. Please refer to Pro-Face for details on assigning IP addresses. In our example we have set the HMI to an IP address of 192.168.1.200.

Next, install the GP-Pro EX software from Pro-Face. Once installed, start the software and choose a new project. In our example we are using the model AGP-3600T. Click next and you will be brought to the Device/PLC screen. Here we need to choose the manufacturer as Schneider Electric Industries (this is the manufacturer who Pro-Face chose to associate with Modbus). Then set the series to “MODBUS TCP Master” and the port should be set to “Ethernet (TCP)”. Then click “Communication Settings”

Select the Device/PLC1 that we added. At the bottom of this screen we see the “Device Specific Settings”. We need to tell the HMI how to communicate to the RIO. To do this we click on the icon underneath “Settings” which will bring up a new window labeled “Individual Device Settings”.

Under the “Equipment Configuration” tab we need to first specify the IP address of the RIO. In our example we will enter 192.168.1.47 In the same tab there is a box labeled “Double Word word order”. This must be changed to “High word first (H/L)”. This setting changes how the HMI interprets responses from the RIO. Next change to the “Max Query” tab. Here we will specify how many IO points there are. We set the first three boxes to 16 bits and the last three to 8 words.

The screenshot shows the 'Individual Device Settings' dialog box for PLC1, with the 'Equipment Configuration' tab selected. The 'Equipment Address' section contains the following fields:

- IP Address: 192 168 1 47
- Port No.: 502
- Unit ID: 255

The 'Bit manipulation (set/reset) to Holding Register' section has two radio buttons: 'Clear' (unselected) and 'Do not clear' (selected). Below this is a note: "Note on when selecting 'Do not clear': If the ladder program writes data to Holding Register during the read/write process, the resulting data may be incorrect."

The 'IEC61131 Syntax' section has a checkbox for 'IEC61131 Syntax' (unchecked) and a dropdown for 'Address Mode' set to '0-based (Default)'. A note below reads: "If you change the series, please reconfirm all address settings."

The 'Variables' section has a dropdown for 'Double Word word order' set to 'High word first(H/L)' and a checkbox for 'Low Security Level' (unchecked).

Buttons at the bottom include 'Default', 'OK (O)', and 'Cancel'.

The screenshot shows the 'Individual Device Settings' dialog box for PLC1, with the 'Max Query' tab selected. It displays a table of query parameters:

Address	Function Codes	Max Query
Coil (0)	Read (01H)	16 bits
Coil (0)	Write (0FH)	16 bits
Discrete Input (1)	Read (02H)	16 bits
Input Register (3)	Read (04H)	8 words
Holding Register (4)	Read (03H)	8 words
Holding Register (4)	Write (10H)	8 words

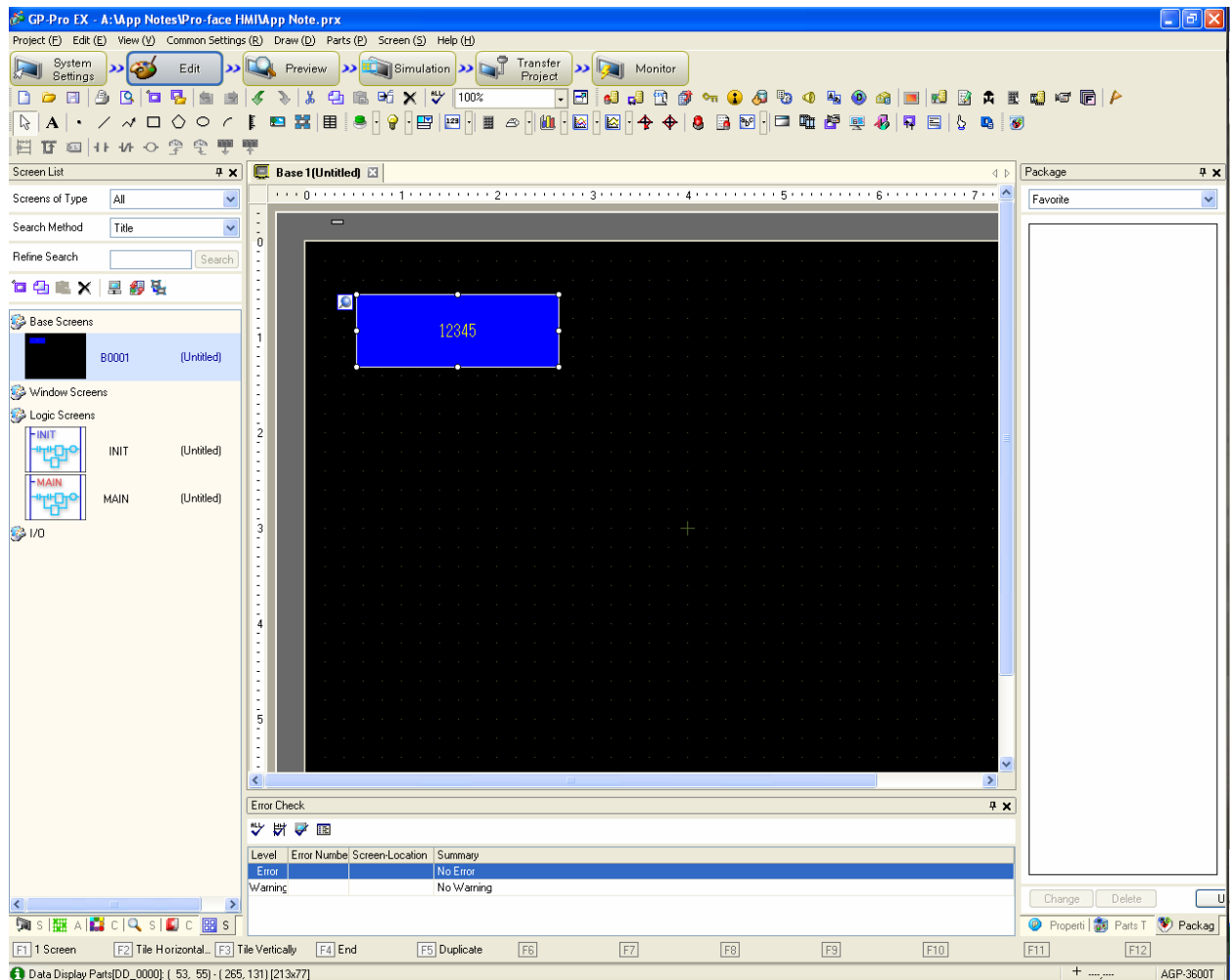
There is a checkbox for 'Single Bit manipulation to Coil/Discrete Input' which is unchecked.

Buttons at the bottom include 'Default', 'OK (O)', and 'Cancel'.

We now need to set up the GP-Pro Ex software to be able to communicate to the HMI. Choose the “Project” menu then *Transfer Project / Transfer Settings*. Set the communication port to LAN. Click OK and then Close from the main Transfer Tool menu. This will bring you back to the GP-Pro EX software.

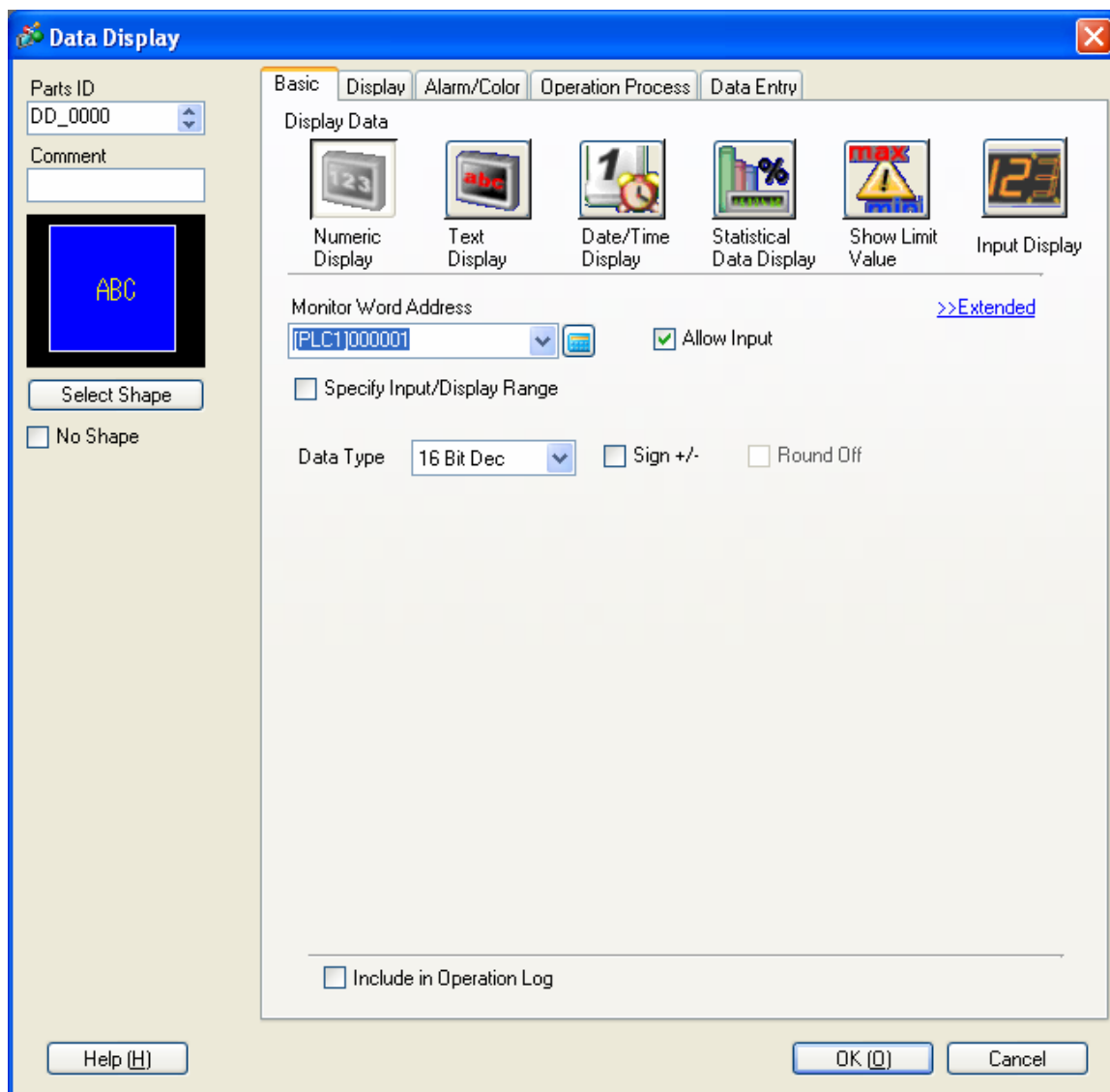
Designing the HMI Screen

Near the top of the screen you will find a series of six buttons; click the “Edit” button. This will bring you to a new screen where we can edit the HMI screen. On the left side, double click on the black box under “Base Screens”. This should load a black background screen in the main window of the screen. At this point we want to add a “Data Display”. On the top menu bar there is a menu labeled “Parts”. Click this then *Data Display / Numeric Display*. Using the mouse click and drag to create a box. Your screen should look similar to our example below.



Reading and Writing Digital Outputs

Double click on the Data Display box we just created. In this menu we will tell the HMI which IO points we want to access with this box. First, check the box “Allow Input” because we want to be able to set our digital outputs. Then click on the icon next to the drop down menu that says “[PLC1]400001”. This will bring up the Input Address menu where we want to change the first digit to a “0” using the drop down menu. This address specifies to the HMI that we are reading and writing to the digital outputs. The suffix can remain at 00001. After clicking “Ent” the screen should look similar to the one below. This data box will allow us to display and adjust all 16 of the digital outputs using a decimal representation of a 16 bit binary number where a 1 is on and a 0 is off.

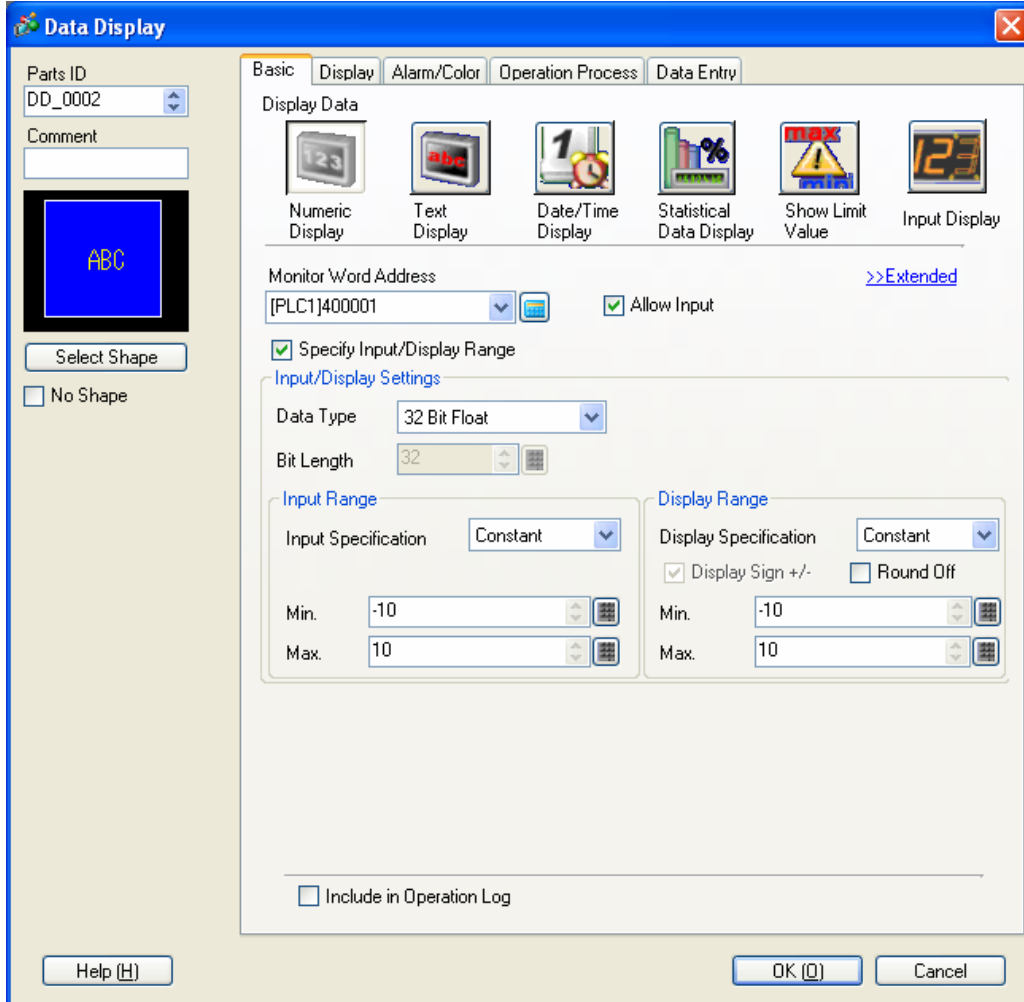


Reading Digital Inputs

Using the same method as above, add another data box. Double click on the new box and change the address to lead with a 1. This specifies the digital inputs. In this case we will *not* check the box “Allow Input” as it does not make sense to set digital inputs

Reading and Writing Analog Outputs

Add a third data box. Double click and change the address prefix to be a 4 which specifies analog outputs. The address of 400001 actually corresponds to analog output 0 on the RIO. This can be adjusted to select any of the analog outputs. This time we will check the box “Specify Input/Display Range” as well as the “Allow Input” box. Change the data type to “32 Bit Float”. The “Input Range” and “Display Range” will both need to have a min of -10 and a max of 10.² Verify that the box marked “Round Off” is *not* checked.

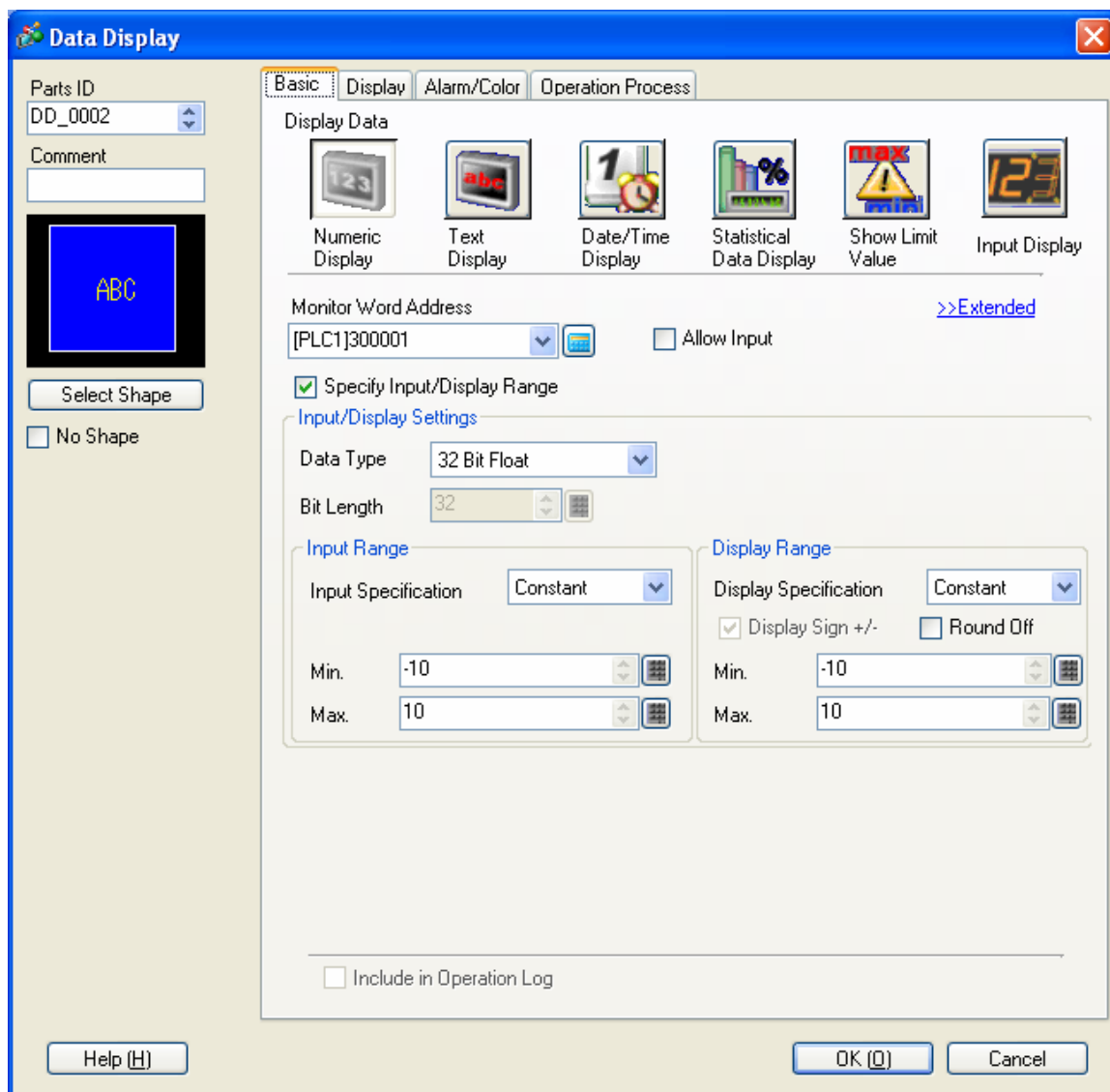


² The +-10V range is specific to certain models of RIO. Please consult Galil for more information

Still in the data display window we need to move to the “Display” tab. Here we change the decimal places to 2. We can then click OK to save the changes we’ve made.

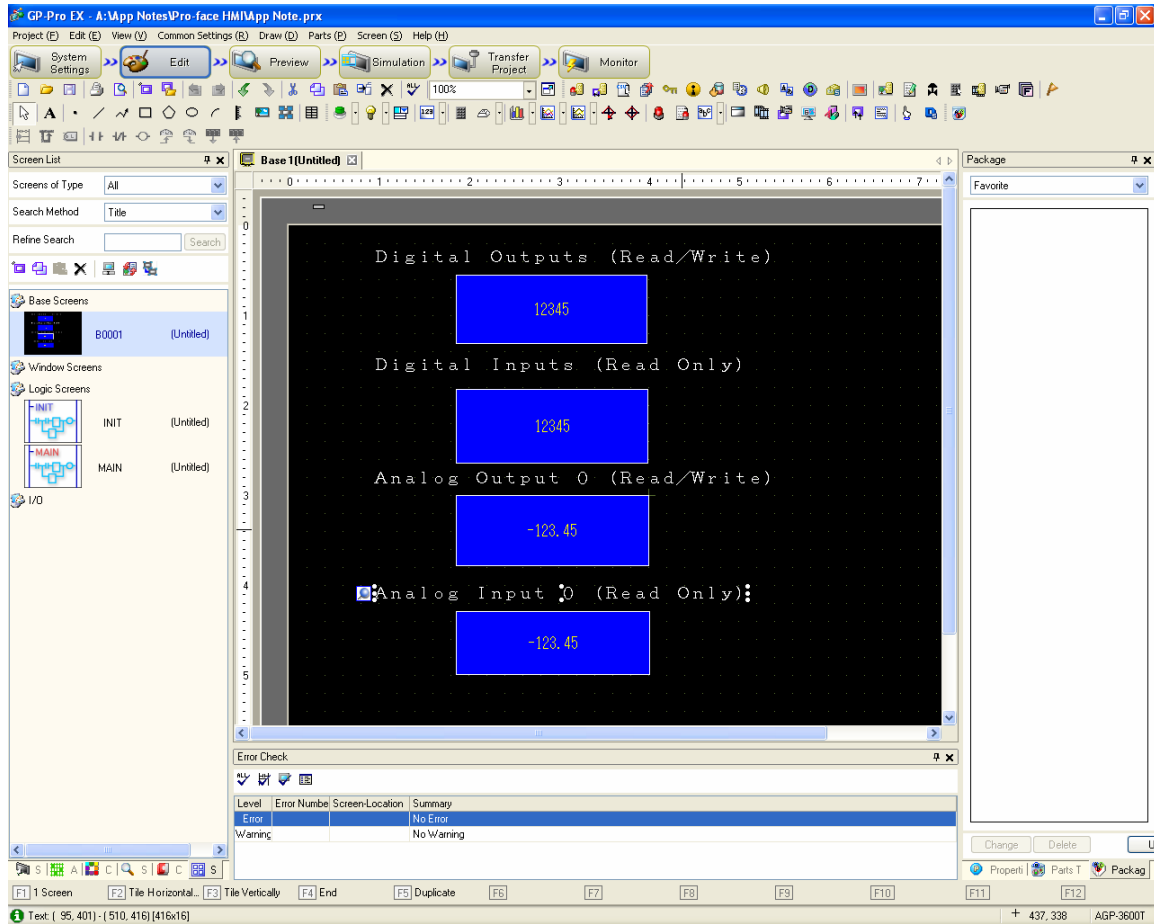
Reading Analog Inputs

The 4th box we add will be for the analog inputs. Again following the same procedure as above, draw another data display box. This time set the address prefix to 3. Leave the second part of the address at 00001 which specifies analog input 0 on the RIO. Check the “Specify Input/Display Range” box, but not the “Allow Input” box. Set the “Data Type” to 32 Bit Float and again set the min to -10 and the max to 10 for both the “Input Range” and “Display Range”. Uncheck the “Round Off” box. Move to the “Display” tab and increase the number of decimal places to 2.



Applying Labels

Now we want to add simple labels for our four boxes. Go to the Draw menu and select text. Draw a text box just above our first box (digital outputs) and then double click in it. Replace the text with “Digital Outputs (Read/Write)”. Also change the text size to something reasonable, in our case we chose 16x16 pixels. Repeat this step 3 more times and add the following labels; “Digital Inputs (Read Only)”, “Analog Output 0 (Read/Write)”, “Analog Input 0 (Read Only)”. Your screen should look similar to the one below.



Transferring the Project to the HMI

With our example project complete we are now ready to transfer it to the HMI. Near the top there is a large button “Transfer Project”. Click this button. It will ask you to save the project.

You will then be brought to the transfer tool. From here we need to select the top button, “Send Project”. The next menu called “Select Display Unit” should discover the HMI unit. In our example it is set with IP Address 192.168.1.200. Check the box next to the IP address and then click OK to begin the transfer process.

Testing Our Project

After the project has been transferred the HMI should open a connection to the RIO and begin displaying the information. With nothing set on the RIO, the digital and analog outputs should read zero. The digital inputs default to a 1 when not activated so the display should read 65535 (1111111111111111 binary = 65535 decimal). The analog inputs are pulled up internally to about 2.5V.

Start by testing the digital outputs. On the HMI, double tap on the 1st box for digital outputs. A keypad should display; type in 65535. This should turn on all the LED's for the digital outputs on the RIO hardware. Furthermore, in the GalilTools software using the watch window we should see all 16 digital outputs are now set to 1. From the terminal in GalilTools send the command "CB15" (without the quotes). This will turn off output 15. The HMI should now read 32767 (0111111111111111 binary).

To test the digital inputs we will need to activate one of the inputs. Please refer the RIO user manual for details. With none of the inputs activated, the display should read 65535. (1 is inactive and 0 is active). If we activate input 15 the display should read 32767 (0111111111111111 binary).

The analog outputs can be tested by double tapping on the last box. When the keyboard pops up, select any value between -10 and +10. Go back to the GalilTools software and verify in the watch window that analog output 0 is set to the value you specified. Then in the terminal send the command "AO0,-5" (without quotes) to set analog output 0 to -5V. This should be reflected on the HMI.

To test the analog inputs you can connect a wire from Analog Input 0 to analog ground. You should see the 4th box in the HMI change from ~2.5V to 0V.

This example demonstrates how to get basic communication set up between a Pro-Face HMI and a Galil RIO. Many more advanced features and capabilities are included in both the HMI and the RIO that are not demonstrated in this note. By using Modbus to communicate between these two devices the system designer can utilize a time-tested and easy-to-implement architecture which will allow for a reduction in set up time and still provide a powerful system of IO controlled by user input.

For application specific questions, or more information on the RIO, please contact a Galil Application Engineer at 1-800-377-6329