Application Note #5487

Connecting a low cost Maple Systems OIT and a Galil RIO

The RIO-47xxx family of pocket PLC's provide a very low cost and high value solution to remote IO control. For example, the RIO-47100 includes 16 digital inputs, 16 digital outputs (all optically isolated) plus 8 analog inputs and 8 analog outputs and Ethernet communication all at a low price. Many systems that require low cost remote IO also require a low cost way for humans to interface with this IO. The Maple Systems MicroOIT line of Operator Interface Terminals can meet this requirement.

In this example we will explore communication between an RIO-47120 and a Maple Systems OIT3165, however in theory any Galil RIO and any Maple OIT should work the same. Furthermore, a Galil motion controller with an RS-232 port, such as the DMC-21x3 or DMC-40x0, will behave the same as the RIO and could be used with the OIT instead of an RIO.

Hardware

1. RIO-47100 – Galil PLC
    a. http://www.galilmc.com/products/rio-47xxx.php
2. OIT3165 – Maple Systems Operator Interface Terminal
3. 7431-0096 – Maple Systems communication cable
4. Male-to-Female RS-232 Null Modem Converter
5. PS-2.5-24 – Galil 24V power supply
    a. http://www.galilmc.com/support/appnotes/accelera/note2516.pdf

Software

1. GalilTools Lite – Free software for programming Galil controllers
    a. http://www.galilmc.com/products/galiltools.php
2. STEPware-100 – Maple Systems software for programming OIT
    a. http://www.maplesystems.com/

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Setup

Before applying power to the RIO, install the jumper labeled "19.2". This is the fastest baud rate this version of OIT will communicate at. Next, apply power to both units. In our example we use a PS-2.5-24 from Galil. This will require splicing the power output into two connections; one for connecting to the RIO with the supplied Molex connector and one with flying leads to screw into the OIT.

Programming the RIO

The RIO has the ability to simultaneously execute local programs and receive commands from 3rd party devices. To program the RIO we will use GalilTools Lite and connect via Ethernet (RS-232 would work just as well).

In this example we will write a simple program that performs two tasks

1. Turn on a temperature controlled oven.
2. Turn on a digital output for 5 seconds and then turn off output 5 if input 1 is active or if input 1 is inactive leave output 5 on and turn on output 6. Wait 10 seconds then repeat.

For the temperature control section we will set up all of the parameters upon power up of the controller, and then send the final commands from the OIT. Item #1 above will need to be written in a DMC program on the RIO and then executed from the OIT. The DMC program would look like Table 1

Command	**Description**
#AUTO	*Special label that causes the program to run upon power up*
AQ0,3	*Set analog input to 0-5V*
DQ0,4	*Set analog output to+/-10V*
setpt=.012*20+2	*20 degrees C is desired setpoint. .012 is deg/V for RTD*
CL1000	*loop update rate of 1 second*
KP25	*Set proportional filter to 25*
KD50	*Set derivative filter to 50*
KI0	*Set integrator filter to 0*
DB.024	*Set dead band to 2 degrees C (.012deg/v*2deg)*
AF0	*Analog input 0 as feedback*
PSsetpt	*Set the desired set point to the variable "setpt"*
EN	*end this section of program*
#OUTPUT	*Label*
SB5	*Turn on output 5*
WT5000	*Wait 5000ms (5sec)*
IF@IN[1]=0	*If input 1 is active then…*
CB5	*Turn off output 5*
ELSE	*Otherwise…*

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SB6	*Turn on output 6*
ENDIF	*End the IF statement*
WT10000	*Wait 10000ms (10sec)*
JP#OUTPUT	*Jump back to #OUTPUT forever*

Table 1 – RIO program

Upon power up, the RIO will begin executing commands at the #AUTO label. This will set up all the parameters for the temperature control, but will not begin PID control until the AZ0 command is sent from the OIT. Program execution will stop at the EN command. We will begin the #OUTPUT section by sending a XQ command from the OIT.

After the program is written in GalilTools, download it to the RIO and then issue the BP command to burn it into non-volatile memory.

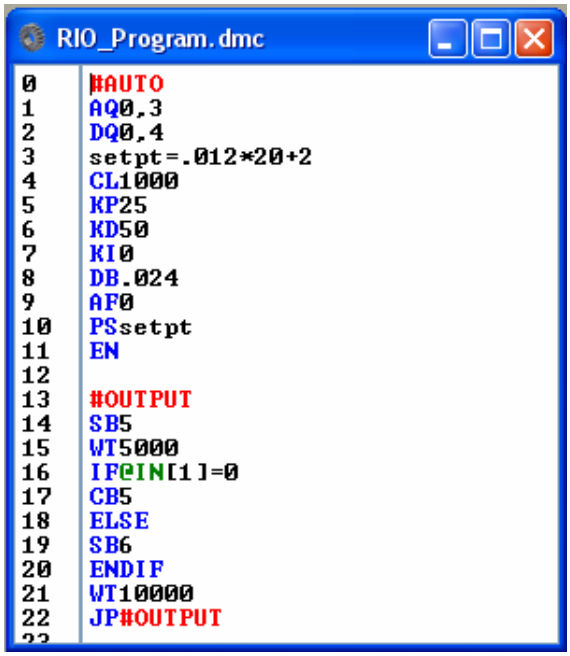

Figure 1 – RIO Program

Programming the OIT

To program the OIT we will use the STEPware 100 software from Maple Systems.

Start a new project which will take you to the configuration editor. Set the baud rate to "19200". Uncheck the box "local echo enabled". By default, the RIO will echo back the commands (this can be adjusted with the EO command on the RIO)

Next we will change the function keys on the OIT to send the appropriate commands to the RIO. Go to the *Tool* | *Function Key Editor* menu. We will start with F1. Change the action to "Push On/Off". Then click on the *Edit* under "Key ON Message". With this screen we can program the OIT to send any ASCII string we need. The F1 key will be used to enable and disable the temperature control loop (Item #1 above). Enter the string AZ0 (all upper case). This is the Galil command to use analog output 0 for the PID control. Coupled with the program we downloaded and executed it will begin the PID temperature control on the RIO. In the 4th element click on *Non-Printable* and select {CR} for carriage return. Your screen should look like Figure 2.

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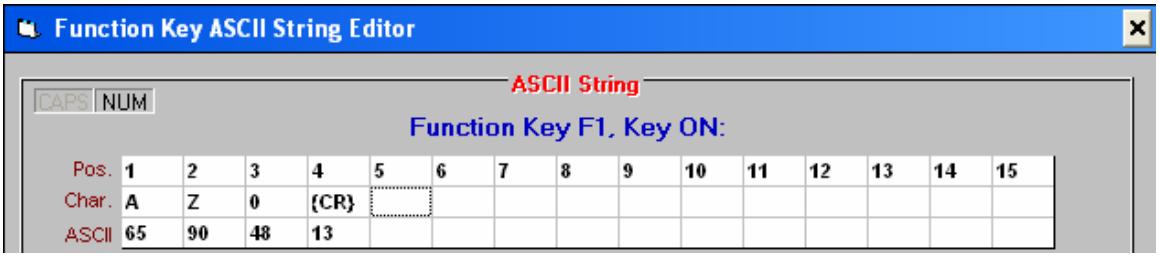

Figure 2 - Programming OIT Function Keys

After entering the string, click "Done". Similarly, we will now edit the "Key OFF Message". This means that the second time we push the F1 button we will send a different string. In this case, we will now send AZ-1{CR}. This will disable the temperature PID control on the RIO.

Moving to the F2 button, we will again change the action to "Push On/Off". This button will be used to start our digital logic (Item #2 above). This will require that we begin executing the program on the RIO starting at the label #OUTPUT. To do this, we will have the OIT send the command XQ#OUTPUT{CR}. The "Key Off Message" will be ST{CR} to stop the program execution.

Next we need to pass the program to the OIT. We will use the Maple Systems cable 7431-0096 connected to the serial port of our PC without any null-modem connectors. Set up the OIT to receive the program (consult OIT manual for details). In the STEPware software go to the Transfer Menu and click send to OIT.

Testing Communication

To test communication we will move the serial cable from the PC to the RIO and install the male-female null modem adapter. It is important that Tx and Rx are swapped from the standard Maple System cable in order for the OIT to communicate to the RIO.

With the RIO still connected to the PC via Ethernet we can open the Watch Window in GalilTools and view the analog output (@AO[0]) and Output 5 and 6 (@OUT[5] and @OUT[6]). When we push F1 on the OIT, the analog output should go to 9.9V (assuming no analog input is connected). This is because the PID loop sees a set point of 2.2398V and the analog feedback is 0V and applies a correction to analog output 0. When we push the F1 button again the PID loop is disabled, and the analog output returns to 0.

Similarly, pushing the F2 button on the OIT with no digital inputs connected will cause output 5 to turn on and five seconds later output 6.

Summary

Combining the Galil RIO family Pocket PLC's with a Maple Systems OIT offers a cost effective and easy to set up IO and interface system. For more details on the RIO or this application note please contact a Galil Application Engineer at 1-800-377-6329.

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