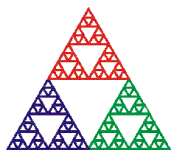


# A360

## Dual Fiber-optic Loop Controller

### User Manual



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### 3 Safety Information

This unit is designed for compliance with harmonized electrical safety standard EN61010-1:2000. It must be used in accordance with its specifications and operating instructions. Operators of the unit are expected to be qualified personnel who are aware of electrical safety issues. The customer's Responsible Body, as defined in the standard, must ensure that operators are provided with the appropriate equipment and training.

The unit is designed to make measurements in **Measurement Category I** as defined in the standard.

The unit must not be operated unless correctly assembled in its case. Only Service Personnel, as defined in EN61010-1, should attempt to work on the disassembled unit, and then only under specific instruction from Pyramid Technical Consultants, Inc..

The unit is designed to operate from +24VDC power, with a typical maximum current requirement of 200 mA. An auxiliary power output is provided from which up to 1.1 A @ 24 VDC can be drawn. A suitably rated power supply module is available as an option.

A safety ground must be securely connected to the ground lug on the case.

Some of the following symbols may be displayed on the unit, and have the indicated meanings.



Direct current



Earth (ground) terminal



Protective conductor terminal



Frame or chassis terminal



Equipotentiality



Supply ON



Supply OFF



CAUTION – RISK OF ELECTRIC SHOCK



CAUTION – RISK OF DANGER – REFER TO MANUAL

## 4 Models

A360	Dual fiber-optic loop controller

## 5 Scope of Supply

A360 model as specified in your order.

PSU24-40-1 24 VDC power supply.

CAB-LR-3-LR Cable, 2.1mm threaded jack termination both ends, 3' for auxiliary output power.

CAB-RJ45-3-RJ45, Cable, Ethernet CAT5, 3'.

CAB-ST-HCS-10-ST (qty 2), Cable, fiber-optic, ST terminated, 10'

USB memory stick containing:

- A360 User manual

- PTC DiagnosticG2 software installation files

- Test data

Optional items as specified in your order.

OEM customers may not receive all the items mentioned.

## 6 Optional Items

### 6.1 Power supplies

PSU24-40-1 +24 VDC 45W PSU (universal voltage input, plug receptacle for standard IEC C14 three-pin socket) with output lead terminated in 2.1mm threaded jack.

PD-8 Eight output +24 VDC power supply unit, 19" rack mounting

### 6.2 Data cables

CAB-ST-HCS-10-ST Fiber-optic cable pair 200 um HCS fiber ST terminated with color-coded sleeves, 10'. Other lengths available to order.

CAB-ST-P-10-ST Fiber-optic cable pair 1 mm plastic fiber ST terminated with color-coded sleeves, 10'. Other lengths available to order.

### 6.3 Power cables

C CAB-LR-3-LR Cable, 2.1mm threaded jack termination both ends, 3' for auxiliary output power.

## 7 Intended Use and Key Features

### 7.1 Intended Use

The A360 is intended to provide convenient, high-performance connection of Pyramid devices via fiber optic loops. Connection to a host computer system is via a standard Ethernet interface. Fiber-optic communications provide perfect electromagnet noise immunity and the ability to link devices at different electrical potentials. Up to fifteen devices can be connected on each of the two loop ports, although smaller numbers are recommended if communication speed is critical.

The A360 has design features which make it tolerant of electrically noisy environments, but the place of use is otherwise assumed to be clean and sheltered, for example a laboratory or light industrial environment. The unit may be used alone, or networked with other devices and integrated into a larger system. Users are assumed to be experienced in the general use of local area networks, and to be aware of the dangers that can arise in high-voltage circuits.

### 7.2 Key Features

Compact design.

Standard Ethernet port supporting TCP/IP and UDP.

Two fiber-optic loops each supporting up to fifteen devices.

Auxiliary 24 VDC power output.

On-board processors and buffer memory that extend the data collection capability of connected devices.

Various host software options and scripting languages for system automation.

## 8 Specification

Processors	Ethernet processor NIOS II/f, 110 MHz Fiber-optic loop processor NIOS II/f 100 MHz
Memory	32 MB of 32b x 110 MHz RAM for Ethernet processor 16 MB flash memory for Ethernet processor 1 MB 32b x 50 MHz RAM shared memory
Operating system	$\mu$ CLinux 2.6 with high speed FPU instruction block in Ethernet processor. Embedded C (deterministic) with high speed FPU instruction block in fiber optic loop processor.
Ethernet	Fully transformer isolated. Auto negotiation 1000/100/10 Mbps, MDIX capability. TCP/IP and UDP. Static or DHCP IP4 address assignment.
Fiber-optic ports	Two loop ports, each a transmitter / receiver pair, rear panel. Up to fifteen devices per port.
Power input	+24V (+/- 2V) DC, 800 mA max. Fused with 1.1A PTC fuse. A360 internal circuitry fused with 200 mA PTC fuse.
Power output	+24V (+/- 2V) DC, 500 mA max.
Controls	Processor reset button.
Indicators	Four LEDs green for power, device status and Ethernet baud rate.
Case	Stainless steel case, with mounting flanges.
Protection rating	The case is designed to rating IP43 (protected against solid objects greater than 1mm in size, protected against spraying water).
Weight	0.4 kg (0.9 lb)
Dimensions	(see figures 1 and 2).
Operating environment	0 to 35 C (15 to 25 C recommended) < 70% humidity, non-condensing

		vibration < 0.2g all axes (1 to 100Hz)
	Shipping and storage environment	-10 to 50C < 80% humidity, non-condensing vibration < 2 g all axes, 1 to 100 Hz

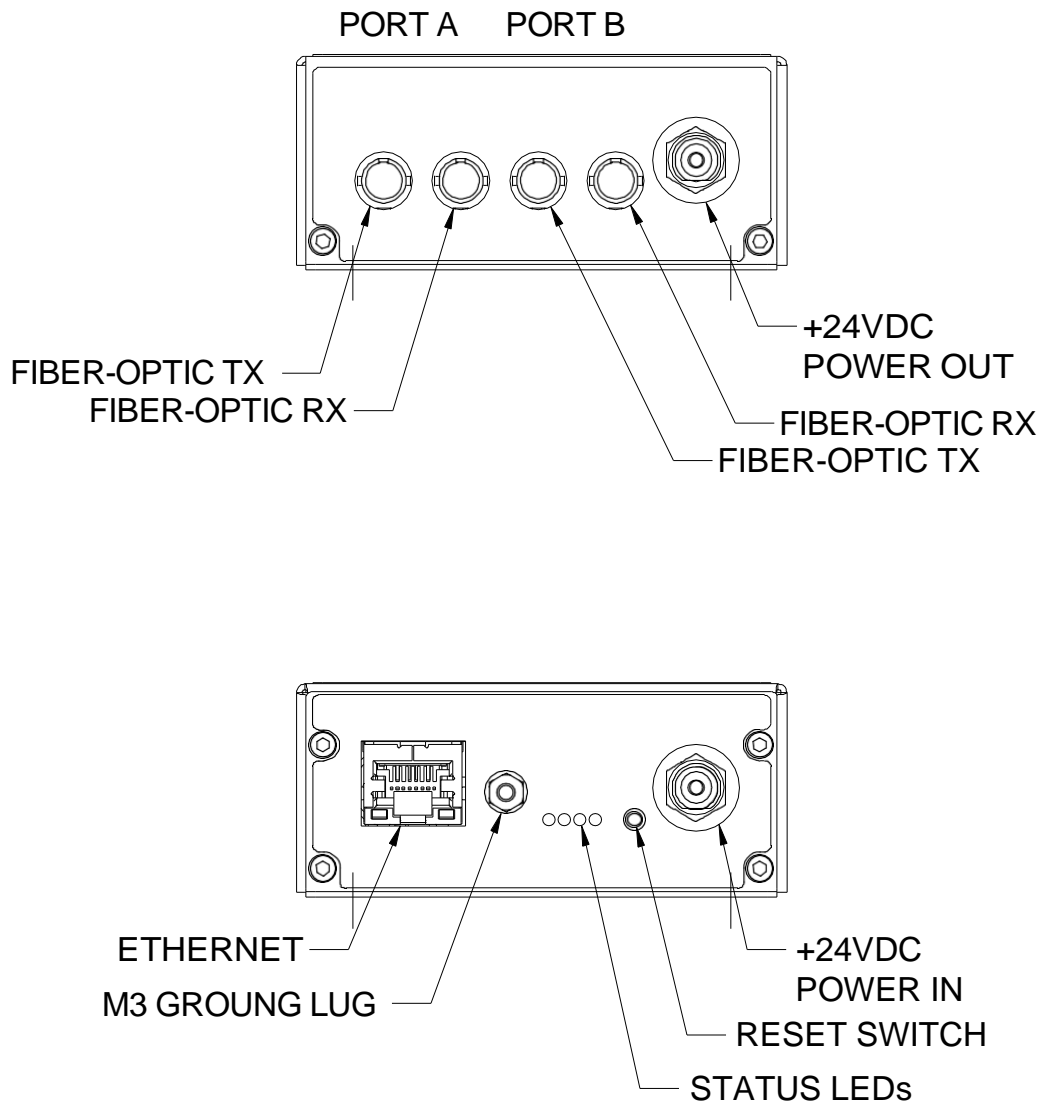


Figure 1. A360 front and rear panels.

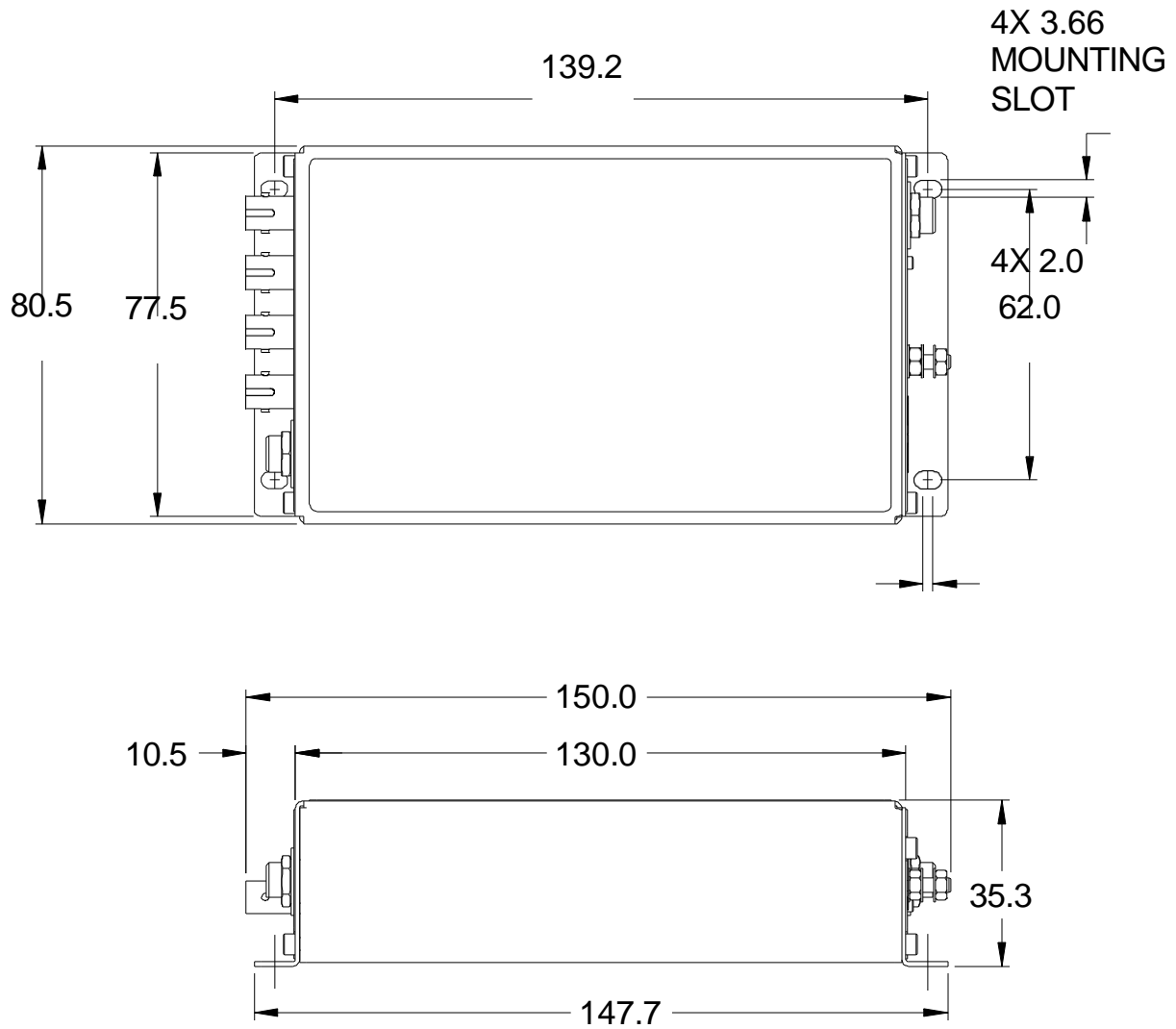


Figure 2. A360 case plan and side views. Dimensions mm.

## 9 Installation

### 9.1 Mounting

The A360 is intended to be mounted in any orientation, or may be simply placed on a level surface. The mounting position should allow sufficient access to connectors and cable bend radii. 60 mm minimum clearance is recommended at the ends of the device.

No forced-air cooling is required, but free convection should be allowed around the back and sides of the case.

### 9.2 Grounding and power supply

A secure connection should be made using a ring lug, from the M3 ground lug to local chassis potential. +24 VDC power should be provided from a suitably-rated power supply with the following minimum performance:

Output voltage	+24 +/- 0.5 VDC
Output current	1000 mA minimum, 3000 mA maximum
Ripple and noise	< 100 mV pk-pk, 1 Hz to 1 MHz
Line regulation	< 240 mV

The A360 includes an internal automatically re-setting PTC fuse rated at 200 mA for its own circuitry. A further 1.1A automatically re-setting PTC fuse limits the amount of current that can be supplied by the auxiliary power output.

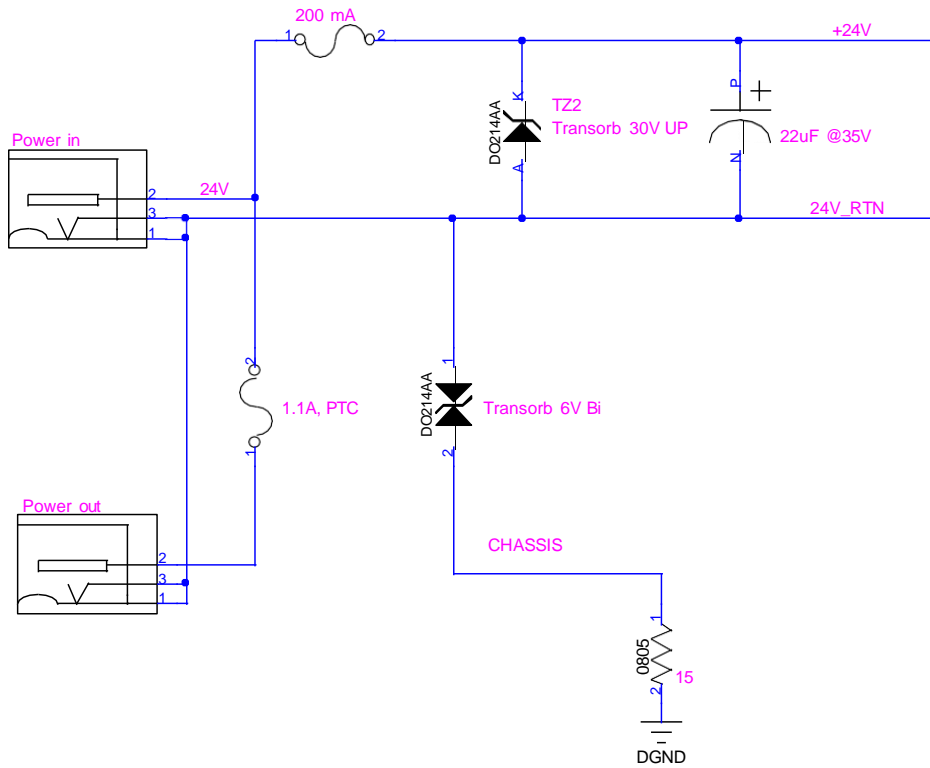


Figure 3. 24 volt input circuit

The external supply should in no circumstances be rated higher than the connector limit of 5 A.

## 9.3 Loop configurations

### 9.3.1 Single device

The simplest use of the A360 is to provide a means of connecting a single Pyramid device to an Ethernet port. The auxiliary power output can be used to power the slave device. The schematic example below shows an A360 interfacing a Pyramid M10 general purpose I/O device, which in its turn could be controlling a power supply, motor or similar device. The A360 connects to the host PC via a direct Ethernet patch cable.

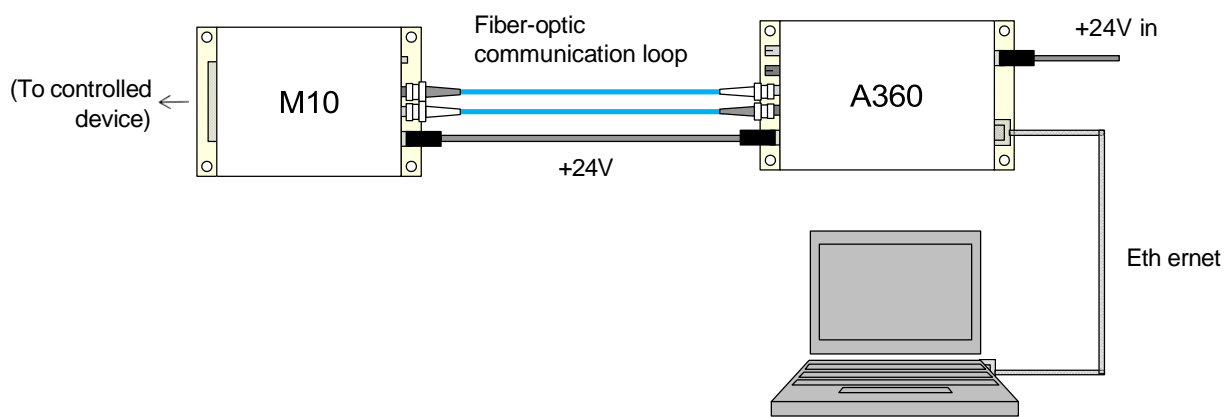


Figure 4. Connecting a single device

### 9.3.2 Multiple devices

The A360 has two loop ports, each capable of connecting up to 15 devices. The slave devices are locally powered. Each device can have a large number of I/O points; a large scale system can be built up even with a single A360. The schematic example in figure 5 shows four looped remote devices on the first fiber optic loop port and three on the second loop port. The A360 is connected via a switch to illustrate how it can be connected to a local area network. The fibers can be very long, up to several hundred meters if good quality silica fiber is used. The data is completely immune to electrical interference, and the fibers can cross high voltage gaps without problem, so you can control clusters of equipment in high voltage terminals.

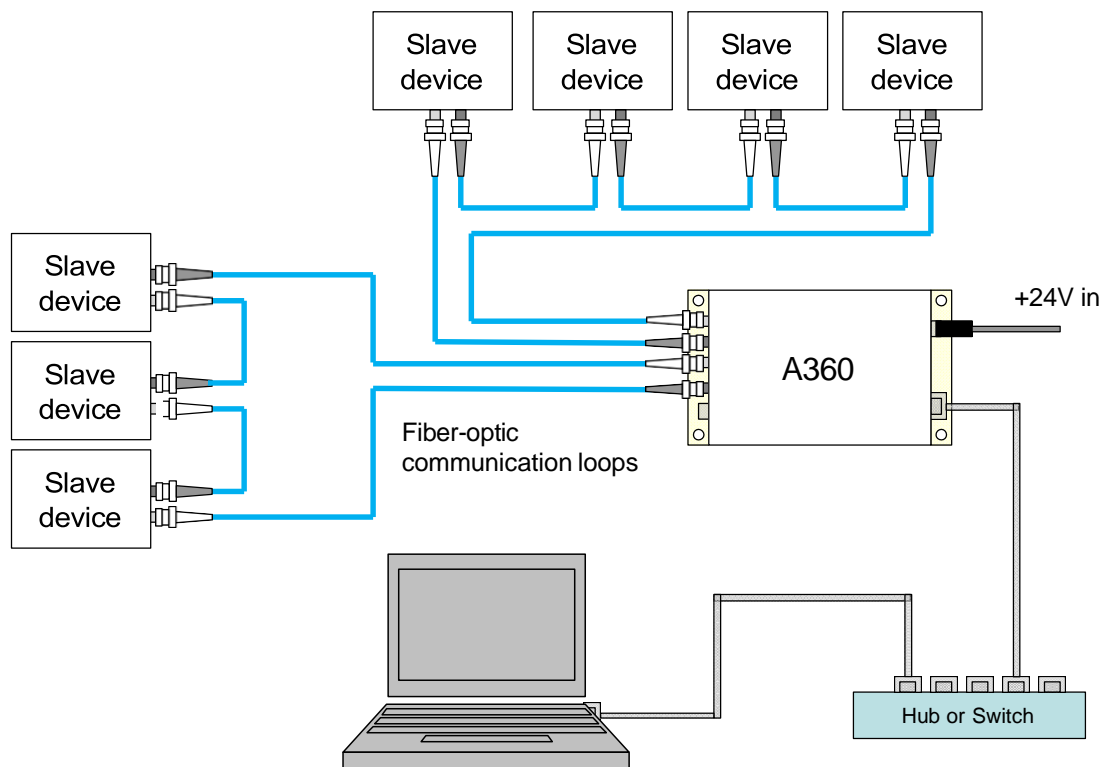


Figure 5. Connecting multiple devices on fiber optic loops

#### 9.4 Connecting fiber optics

Each fiber optic port comprises a transmitter connector (tx: light grey) and a receiver connector (rx: dark gray). The loop is a chain of tx to rx connections. The A360 sends out a message which passes through each device on the loop, dropping off and picking up data. The loop must be complete and connected in the right sequence for the communications channel to work correctly.

The connector is ST bayonet type. It is important that you make the connections correctly to ensure good light coupling, and to avoid damaging the connector. Most ST plugs have a key (or lug) on the central body. This must align with the keyway on the top of the socket on the A360 (see second picture in figure 6) before the plug can be pushed home with minimum effort. The outer shell of the plug can then be rotated while pushing against the spring pressure to engage the bayonet.

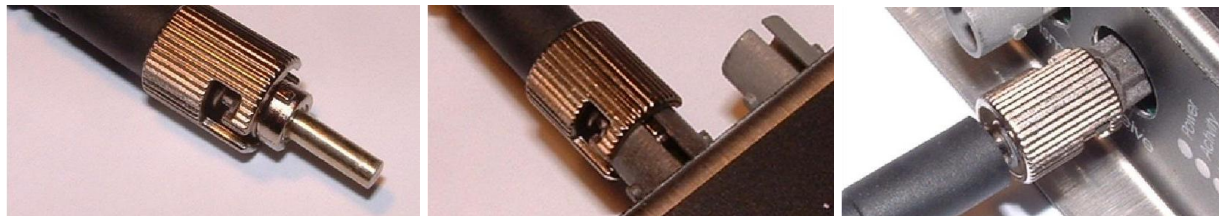


Figure 6. Mating fiber optic connections

## 10 Overview of the A360

The A360 uses the Pyramid A60 processor card, which is common to all Pyramid “G2” devices. The A60 is based around a powerful field-programmable gate array (FPGA) chip, and includes two embedded processor cores. One core handles the loop communications, the other manages the Ethernet communications. The A60 has buffer memory that can be used to enhance the performance of devices connected on the fiber loops.

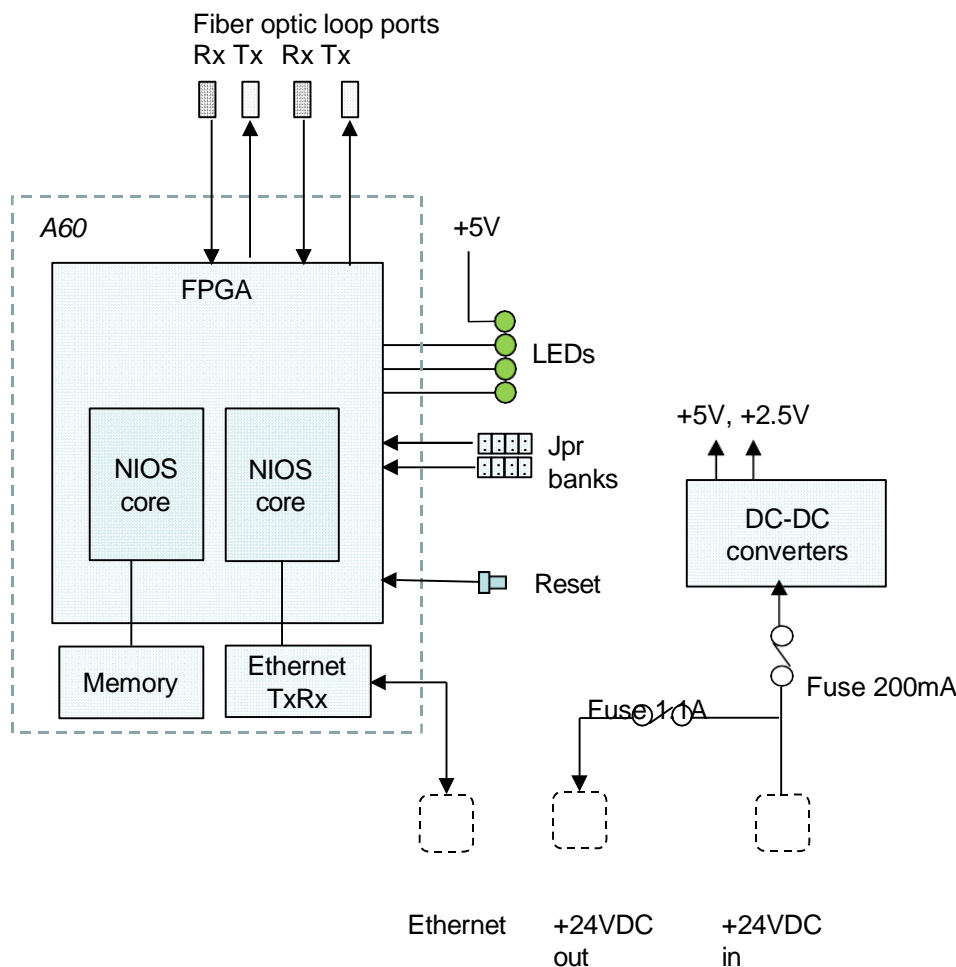


Figure 7. A360 circuit architecture

The main board mounts the A60 card and carries the fiber optic transmitters and receivers, the power conditioning components, status LEDs, reset switch and jumper banks for build-time option selection.

### 10.1 Communication to the host computer

The A360 includes a standard 1000/100/10BaseT Ethernet interface which supports TCP/IP and UDP protocols. The A360 can serve multiple clients on the network. You can either use the G2

Diagnostic host software provided, your own custom software using the PTC\_Controls32 DLL, or the Pyramid IG2 program which provides data connection to an EPICS layer using a Channel Access Server. With the data available via EPICS, you can use one of many EPICS client connections that are available, including ones for Python, Java, C#, Matlab™ and Control System Studio.

## 10.2 Communication to slave devices

The fiber optic interfaces allow devices from the Pyramid range to be connected via robust, noise-immune 10 Mbit/s connections. Up to 15 devices can be connected on each loop. Message packets are sent out by the A360 and received again when they have passed around the loop, loaded with data from the devices. The devices can be mixed in any combination. Device families include:

- I devices for very low current measurement
- F devices for high-speed low current measurement
- C devices for detector pulse counting
- H devices for magnetic field measurement
- M, B devices for general-purpose interfacing
- N devices for actuator control

Visit the Pyramid websites [www.ptcusa.com](http://www.ptcusa.com) and [www.ptceurope.com](http://www.ptceurope.com) to see the full range.

Note that devices share the loop bandwidth, so you should be aware of the tradeoff between system complexity and speed, particularly when connecting multichannel devices that generate data at high rates.

## 10.3 Embedded software

The A360 runs an embedded version of the Linux operating system on the Ethernet NIOS processor implemented in the FPGA. Four firmware files including the operating system make up a full release. You can update with a single zip file which integrates all the releases, and thus ensures that you have compatible versions.

## 11 Getting Started using the PTC Diagnostic G2 Host Program

The PTC DiagnosticG2 is a stand-alone program which allows you to read, graph and log data from devices connected to the A360, and set all the important acquisition control parameters. It also provides access to A360 utilities and the A360 Real-time Processing feature. The Diagnostic uses the same function library that is exposed for users who develop their own host applications, and therefore also serves as a debugging aid.

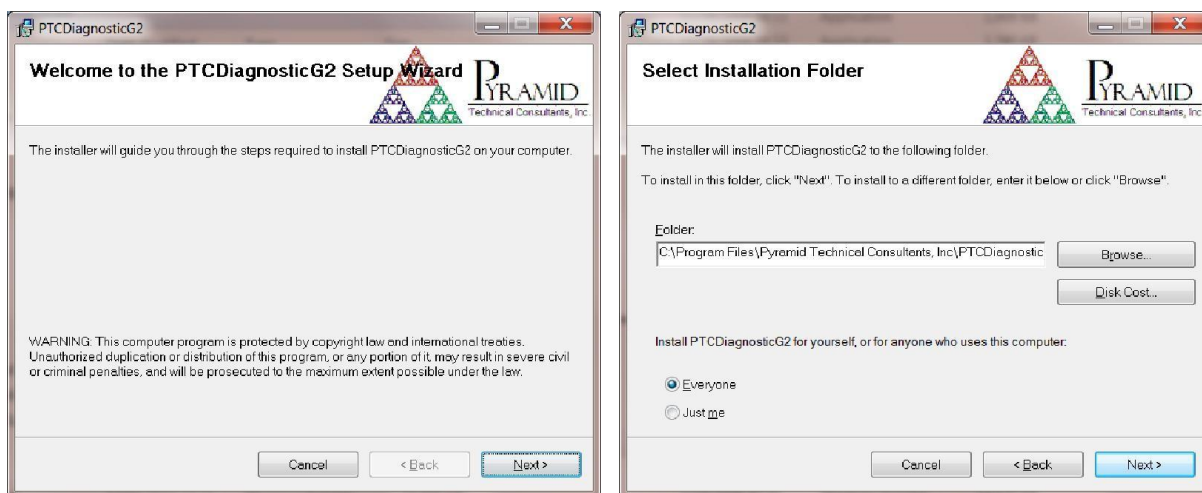
PTC DiagnosticG2 was introduced to support the G2 range of Pyramid Technical Consultants, Inc. products, which feature embedded Linux processors and built-in Ethernet interfaces. It is not compatible with the PSI Diagnostic program which supports previous Pyramid products. However the PTC Diagnostic G2 program will be extended in the future to add support for all the previous products.

Your A360 was shipped with a USB memory stick with the installation files you need. We recommend that you copy the files into a directory on your host PC. Check the Pyramid Technical Consultants, Inc. web site at [www.ptcusa.com](http://www.ptcusa.com) for the latest versions.

### 11.1 Installation

The program runs under the Microsoft Windows operating system. Copy the installer file PTCDiagnosticSetup-Vx\_xx.msi to the hard drive of the host computer, where x\_xx is the version of the Diagnostic. The program will run on Windows XP, Vista, Windows 7 and Windows 8. The PC must have a standard Ethernet port.

Run the installer and follow the prompts. On Windows 7 systems you will be asked to allow the installer to make changes to the computer after the confirmation stage. You will require administrator access to permit this.



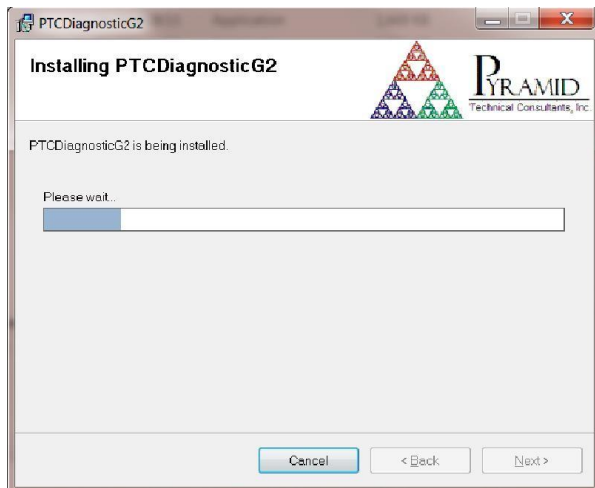


Figure 8. PTC DiagnosticG2 installation

The installer will create a subdirectory in the Program Files directory containing all the executables and configuration files, and create shortcuts on your desktop and in the Start menu.

## 11.2 Connecting to the A360

The following steps take you through the process of connecting to the device.

- 1) It is simplest to start with a direct connection from your host computer to the A360 using a CAT5 or CAT6 Ethernet cable as shown in figure 4. The network cable can be a patch or a crossover type – the A360 automatically adjusts itself to suit. Later, when you have confirmed reliable communication, then you can move the A360 onto a general local area network if required.
- 2) The A360 is set with default static IP address 192.168.100.20 at shipment. Once you have a connection you can change this setting as required. Set up your host PC Ethernet port with a fixed, non-conflicting IP address in the same subnet range, for example 192.168.100.11.

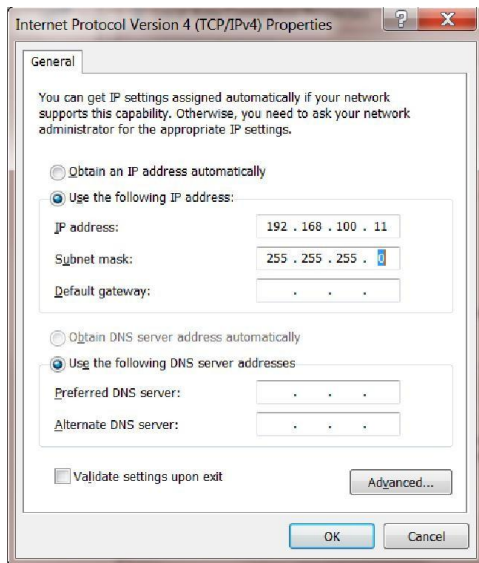


Figure 9. Configuring the IP address on the host computer.

- 3) Turn on 24 V DC power to the A360, but make no other connections. The two power LEDs on the rear panel should illuminate when the power is applied, and the cooling fan will start up. While the device is booting, the left hand bank of four LEDs on the rear panel cycle. When the device is ready, the “Active” and power LEDs only should be illuminated.
- 4) Make the Ethernet connection from the host PC to the A360. You should see activity on the LEDs that are mounted in the A360 RJ-45 connector. Check that you can ping the device from a command window prompt.

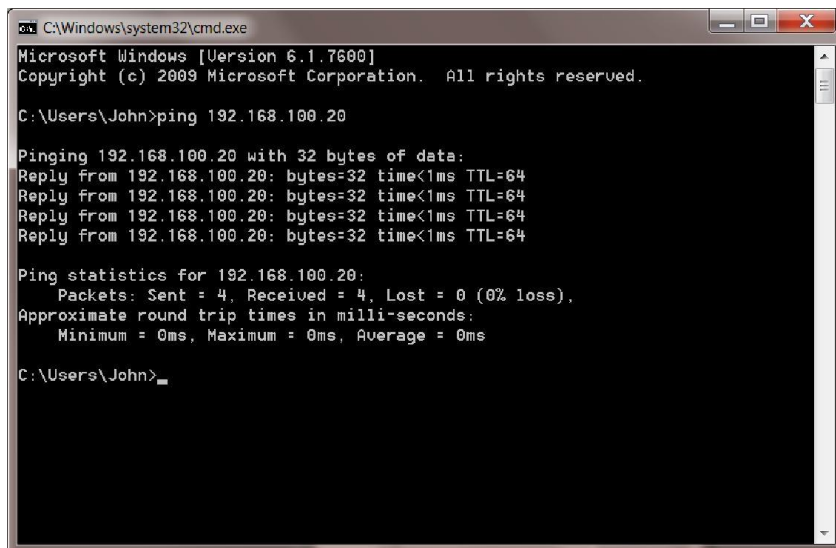


Figure 10. Ping test of the Ethernet connection.

The Windows firewall may block communication with the A360. It is simplest to start by turning off the firewall while you are testing. To maintain security, you can disable any wireless

adaptor on the PC while you are doing this. Once you have established communication, then you can try restoring the firewall, and set up permissions for the PTC Diagnostic to communicate through the firewall. Contact Pyramid Technical Consultants Inc. for latest information about firewall permissions.

6) Start the PTCDiagnosticG2 software. It will start with the Discover Devices dialog open. Click on Discover Controllers and the software will search all IP addresses within its available network looking for compatible Pyramid devices. If you have the simplest possible network, it should find only the A360 you are working with. In the example shown here, the A360 has been set to 192.168.1.68, and two other devices were discovered on the accessible local area network.

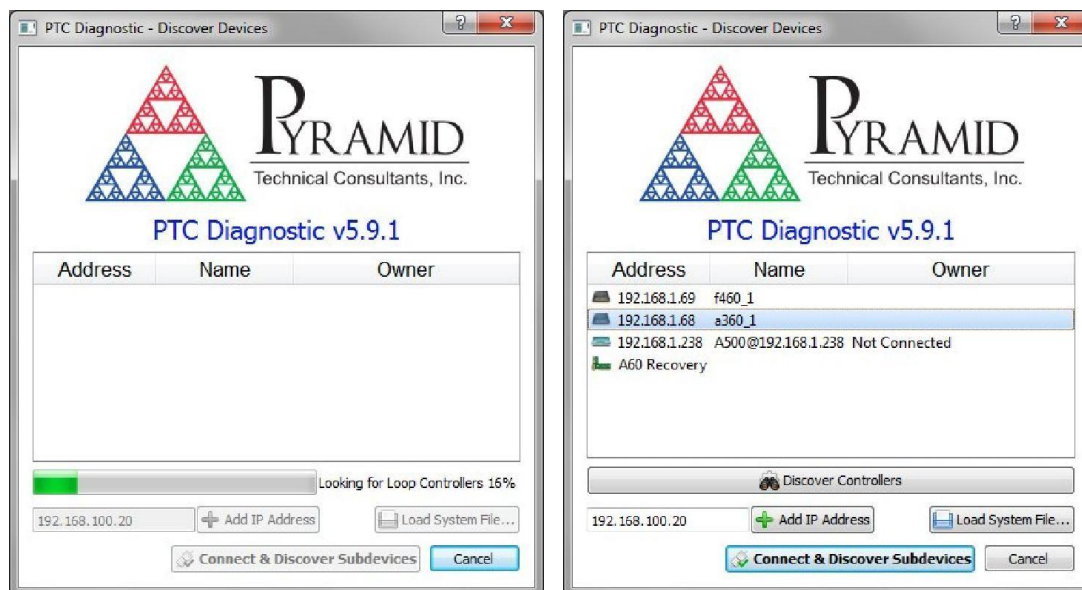


Figure 11. Discovering the A360 and selecting it for connection

In some circumstances the discovered devices may include Pyramid tools such as the A60 recovery utility. You can ignore these.

When you click on the discovered A360, the Connect and Discover Subdevices button is enabled. Click on this to establish the connection to the A360. The System area of the display will show a tree structure with all discovered devices and connected devices highlighted. If a connected device is a loop controller like the A360, then the loops will be listed, and the slave devices will be shown in their loop order and with their loop addresses shown. Note that it is not necessary to have the devices connected in any particular address order on a loop, but that there should be no duplicate addresses on one loop. In the example shown, the A360 has three devices on its loop ports, two on loop one (port A) and one on loop two (port B).

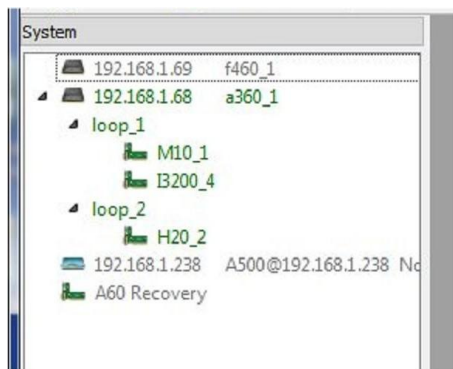


Figure 12. Tree display of discovered and connected devices

Clicking on any highlighted entry in the table will open a window for that device. If you click on the A360 entry, a window for the A360 itself will open, and you will see messages in the message area as the A360 adds your PC as a host. If there are no devices connected on the fiber optic loops, then you will see timeout errors in the message from its failure to connect any loop devices.

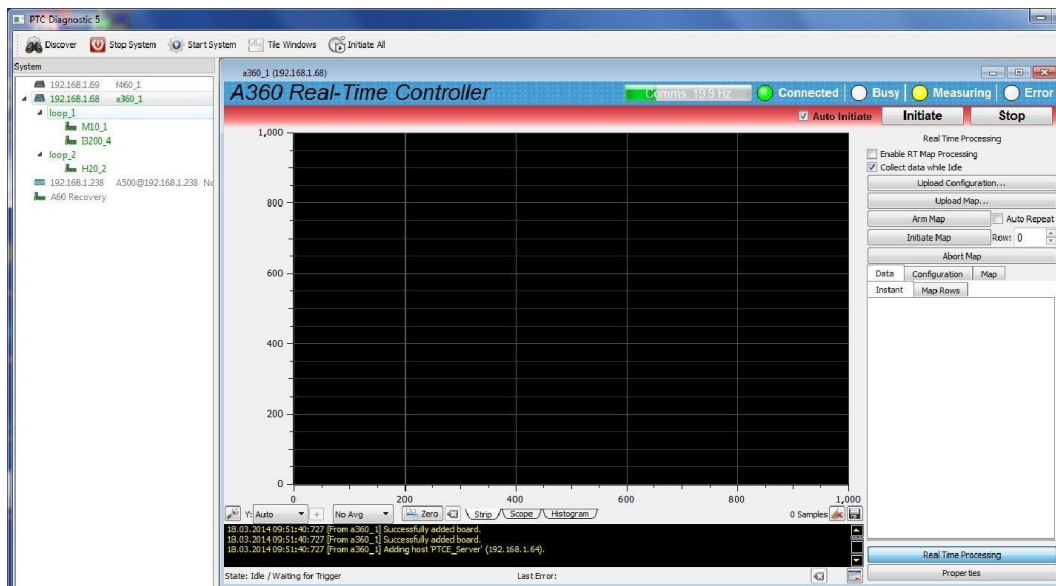


Figure 13. Opening the A360 window

### 11.3 Screen layout

The A360 user interface screen is divided into two halves plus a top banner area.

The top banner is common to all Pyramid G2 devices contains the following indicators:

<b>Comms bar</b>	When moving, this indicates that messages from the A360 are being received by the PTCDiagnosticG2 program. The message frequency is
------------------	---

	displayed.
<b>Connected LED</b>	When lit, this indicates that communications are valid and the system is not in error.
<b>Busy LED</b>	When lit, this indicates the A360 is busy and cannot respond to inputs.
<b>Measuring LED</b>	This LED has no function for the A360.
<b>Error LED</b>	When lit, a communication error between the A360 and the host has been detected.

On the left below the banner there is a graphic display of the data with controls for how the data is plotted below it. This area is used if the A360 collects data from devices on its fiber optic loops using the Real Time Processing feature.

Below the graphic is a message window which reports all the commands issued to the A360 by the PTC Diagnostic program, and the corresponding acknowledgements. Generally you can ignore this display, but it will be valuable for diagnosis if you have any operating problems.

On the right there is a screen area which changes according to which display option you select.

<b>Real Time Processing</b>	Controls for configuring and executing functions such as map processing. An example would be for general purpose I/O device connected to the A360, such as an M10, to put out a sequence of analog output voltages while measuring one or two analog inputs.
<b>Properties</b>	Firmware version display and update controls, and IP address setting.

## 11.4 Properties

### 11.4.1 Firmware update

The A360 has four embedded firmware installations, which need to be compatible with each other. The installations are the Linux operating system, the NIOS processor real time application and the FPGA programs for primary and secondary FPGAs. In order to simplify the task of updating the firmware and ensuring the versions are all compatible, Pyramid Technical Consultants, Inc. releases A360 firmware as a single integrated file which is unpacked and uploaded to the correct memory areas by the software.

You should ensure that the A360 and the host computer will not be disturbed for the four minutes approximately that the update requires. To perform the update, click the Update All Firmware button on the Properties screen area. The software will now warn about the update process, and ask if you want to proceed.



Figure 14. Firmware update warning.

Navigate to the update file, which is typically about 4-5 Mb in size and has filename A360\_Firmware\_x.x.x.x.zip where x.x.x.x is the version number.

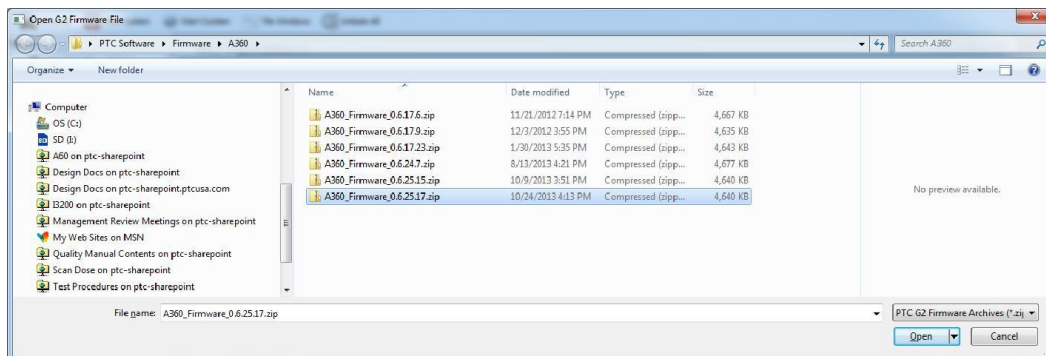


Figure 15. Selecting the firmware file.

While the update is taking place, you will see a countdown of the time remaining, and you can see detailed activities reported in the message window.

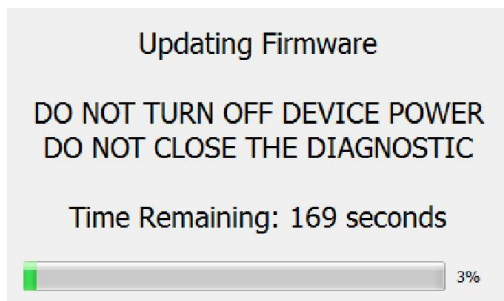


Figure 16. Firmware update status window.

If the process does get interrupted, it is possible that the A360 will not be able to do another update because core programs have become corrupted. In this case you should contact Pyramid or your supplier who can organize a recovery. When the update is complete, you should reboot the device by power cycling it, and check the Properties screen area to ensure that the new versions are correctly reported.

### 11.4.2 Changing the IP address

You can alter the A360 fixed IP address to any valid setting, or set the mode to DHCP if you are connected via a router that provides a DHCP address allocation service.

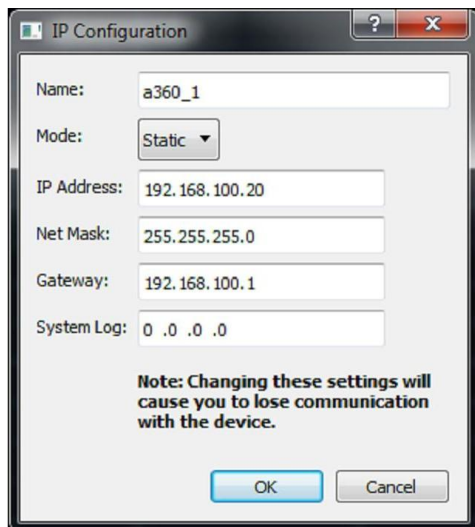



Figure 17. IP address configuration dialog.

Note that the address change takes effect immediately, so you will lose communication in the session you were running. Simply click  Discover on the Diagnostic to rediscover the device. If you have set the IP address outside the subdomain that is accessible to your host computer, you will need to change the IP address of the computer so that it is in the same subdomain as the A360.

### 11.4.3 Restoring the default IP address

You can force the A360 to restore its default IP address of 192.168.100.20 by power cycling and keeping the reset button pressed from the first 2-3 seconds while it boots up.

confusing. In particular, if you attempt to run the IG2 service and PTC DiagnosticG2 on the same computer, the communications will conflict.

## 12 Using the A360 on a network

### 12.1 Network configurations

The A360 uses TCP/IP and UDP communication over standard local area network hardware. Addressing is using the IP4 standard, and it supports static and dynamic (DHCP) address assignment. The device can be configured via the PTC DiagnosticG2, via the serial interface, or by your own host software using the appropriate procedure calls.

Most control and data acquisition systems are set up with fixed addresses assigned by the network administrator. It is also typical to isolate such networks from the internet to prevent unauthorized access, and to allow operation without firewalls which can disrupt communications.

In order for the host computer and the A360 to communicate, they must be within the same subnet. It is typical to limit a local network to 256 addresses by setting the IP4 subnet mask to 255.255.255.0. Then the A360 and the host must have the first three bytes of their addresses common, and must differ in the last byte. For example, the host could be 192.168.100.11 and the F460 192.168.100.20. The last byte must also not conflict with any other devices on the same subnet. Addresses with last byte 0 and 255 are reserved for special functions in TCP/IP.

Note that if you are communicating with the A360 using Ethernet and you change its IP address, then your communication channel immediately becomes invalid. You need to rediscover the device if using the PTC DiagnosticG2, or otherwise change your host software setup as needed. If you have moved the A360 into a different subnet, for example by setting it to a static address of 192.168.1.20 in the prior example, then will also need to the host PC's IP address into the same subnet before you can reconnect.

The simple static IP arrangement allows you to connect using a direct cable connection as shown in figure 18, or via a network switch, as shown in figure 19.

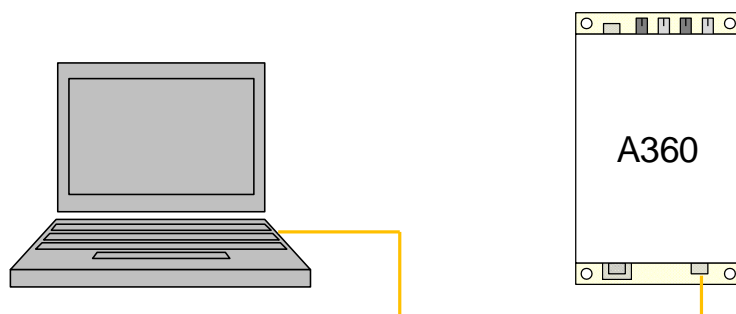


Figure 18. Direct network connection

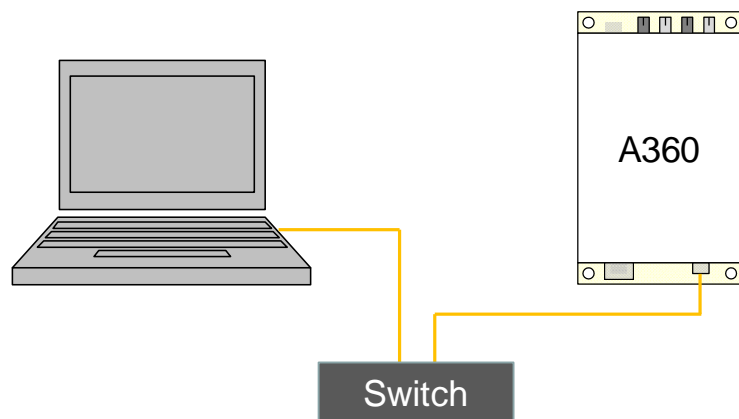


Figure 19. Network connection via switch

Static addressing will also work if the network includes a router, but this arrangement also allows dynamic address assignment by the router. If your host software expects devices to be at specific addresses, this is not appropriate, but it can be helpful for initial testing and for fluid setups. The router will ensure that there are no address conflicts. The Discover utility in the PTC DiagnosticG2 makes the use of DHCP-assigned addresses practical.

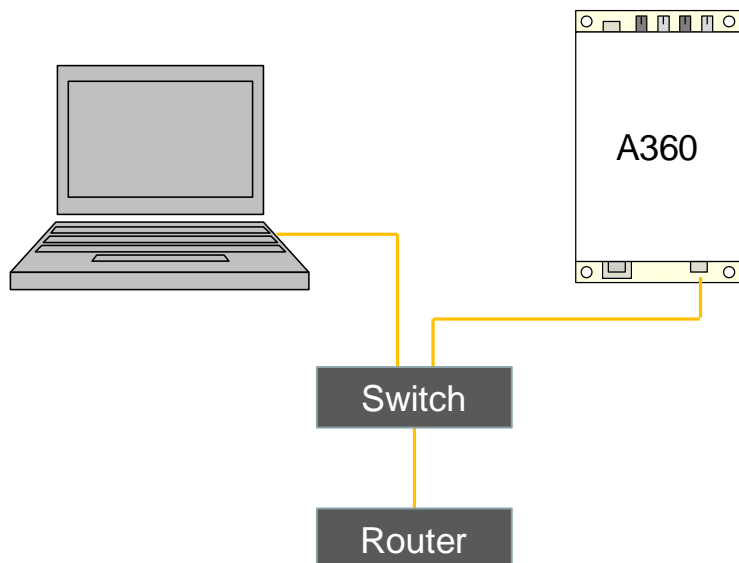


Figure 20. Network including router

You may wish to define the address of this router, or some other access point on the network, as the default gateway, if you want the A360 to be accessible from another network. This is optional.

## **12.2 Firewalls**

Windows Firewall will block one or more of the communication channels required by the A360. We recommend disabling it. This is not a particular risk if the network is isolated from the internet, or protected behind a router firewall.

If you must enable Windows Firewall, however, then you should set up permissions for the programs and data channels that are used. If you are using the PTC DiagnosticG2 then inbound and outbound permission should be set for any protocols for the program, and inbound permission for RPC TCP messages for local port 111.

## 13 Real Time Processing

The A360 can provide a powerful real-time processing service for devices connected on its fiber optic loops.

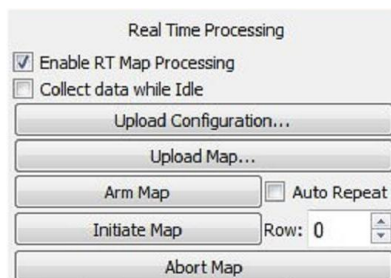


Figure 21. Real time processing controls

The system is described in detail in the following Pyramid Technical Consultants' documents.

PTC1-9-247 A60 Real-Time Controller Software and Configuration Architecture

PTC1-9-679 A60 Real-Time Controller Calculations

The feature allows various parameters to be set on devices connected on the fiber-optic loops, values to be read back and logged to databases, computations to be performed and algorithms to be executed. We shall use a basic example to illustrate real time processing. A sequence of output voltages are delivered from an M10 general purpose interface unit, while readback data is logged simultaneously.

### 13.1 Setting up real time processing

To set up real time processing, you need to tell the A360 which parameters are to be set, and which to be read back. The configuration is set up in an xml file. Full details of the xml schema are given in reference documents. The sequence of output values is defined in a map, which is simply an ASCII csv table of numeric values.

The xml file is shown in two parts below. It starts with standard header text to set up the xml schema.

The map section lists the control values that will be read from the map file, in successive columns. In this case the map will comprise two analog output voltages and a digital bit.

The `loopcontrollers` section tells the PTC DiagnosticG2 program which loop controllers are involved, just an A360 at IP 192.168.1.68 in this example. The `timeslice` parameter is the time in  $\mu\text{sec}$  for each step in the map. The devices connected by the loop controller that will set outputs and read inputs are listed, just one M10 device with address 1 on loop 1 in this example. Specific local names are defined for the particular M10 I/O points that will be used.

```

1  <?xml version="1.0" encoding="iso-8859-1"?>
2  <system
3    xmlns="http://www.ptcusa.com"
4    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
5    xsi:schemaLocation="http://www.ptcusa.com A510.xsd" >
6
7  <map>
8    <channel name="map_dac_X" type="analog" />
9    <channel name="map_dac_Y" type="analog" />
10   <channel name="map_running" type="digital" />
11 </map>
12
13 <loopcontrollers>
14   <loopcontroller type="A360" name="A360_1" ip="192.168.1.68" timeout="50" timeslice="1000" >
15     <loops>
16       <loop number="1" name="A360_1_loop_1">
17         <boards>
18           <board type="M10" name="m10_1" address="1">
19             <channels>
20               <channel name="r_m10_1_ain1" wire="analog_in_1" />
21               <channel name="r_m10_1_ain2" wire="analog_in_2" />
22               <channel name="c_m10_1_aout1" wire="analog_out_1" />
23               <channel name="c_m10_1_aout2" wire="analog_out_2" />
24               <channel name="c_m10_1_dout1" wire="digital_out_1" />
25             </channels>
26           </board>
27         </boards>
28       </loop>
29     </loops>
30   </loopcontroller>
31 </loopcontrollers>
32

```

eXtensible Markup Language file    length : 1882    lines : 65    Ln : 64    Col : 10    Sel : 0 | 0    UNIX    ISO 8859-1    INS

Figure 22. xml file example for real-time processing.

The next section is the `timeslicedatabase` definition which lists the values that will appear on the PTC DiagnosticG2 screen, the two M10 analog outputs and two analog inputs in this example. The database section is the values that will be put into local memory and can be saved to a csv file by the PTC DiagnosticG2.

The processes section controls how the map will be executed. In this example each line of the map will set the two analog outputs and the digital bit to the map value.

```



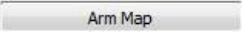
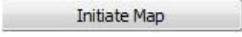
33 <timeslicedatabase>
34 <channel name="c_m10_1_aout1" />
35 <channel name="r_m10_1_ain1" />
36 <channel name="c_m10_1_aout2" />
37 <channel name="r_m10_1_ain2" />
38 </timeslicedatabase>
39
40 <database>
41 <channel name="c_m10_1_aout1" />
42 <channel name="r_m10_1_ain1" />
43 <channel name="c_m10_1_aout2" />
44 <channel name="r_m10_1_ain2" />
45 </database>
46
47 <processes>
48 <process name="profile">
49 <state name="initializing">
50 <test success="done">
51 <argument>0</argument>
52 <target>0</target>
53 </test>
54 </state>
55 <state name="working" />
56 <state name="done">
57 <channel name="c_m10_1_aout1" source="map_dac_X" />
58 <channel name="c_m10_1_aout2" source="map_dac_Y" />
59 <channel name="c_m10_1_dout1" source="map_running" />
60 </state>
61 </process>
62 </processes>
63
64 </system>
  
```

Figure 23. xml file example for real-time processing (continued).

The map format is a simple list of ASCII-coded numbers. In the example the first analog voltage is used to generate a triangle waveform, the second analog voltage a triangle waveform with five times higher frequency. A digital bit is set when the map is running.

```

0,0,0
0.1,0.5,1
0.2,1,1
0.3,1.5,1
0.4,2,1
0.5,2.5,1
0.6,3,1
...(etc)....
-0.3,-1.5,1
-0.2,-1,1
-0.1,-0.5,1
0,0,1
0,0,1
0,0,1
0,0,1
0,0,0
  
```

To run the map, first load the configuration xml file . The message area will report if it was able to read the file correctly. Note that the system area tree will now show the system configuration as you specified it in the file, which overrides any discovered configuration. Next load the map file . Finally arm and initiate to execute the map , .

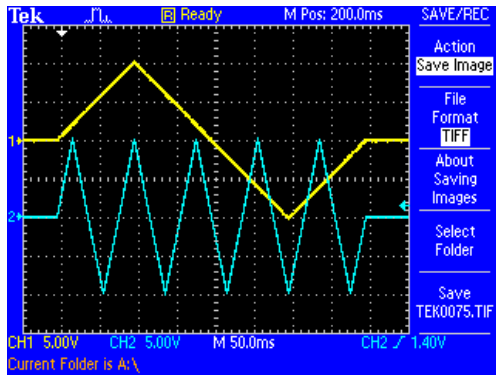


Figure 24. Example analog voltage waveforms produced by map execution.

The parameters you declared in the `timeslicedatabase` section of the xml file are plotted in the graphic area and you can move a cursor and use the horizontal slider to inspect points in the waveforms. The strip chart display is the most useful for real-time processing displays. Note that there is a lag of two timeslices between the output values and readback values. This lag may be visible if you plot both together.

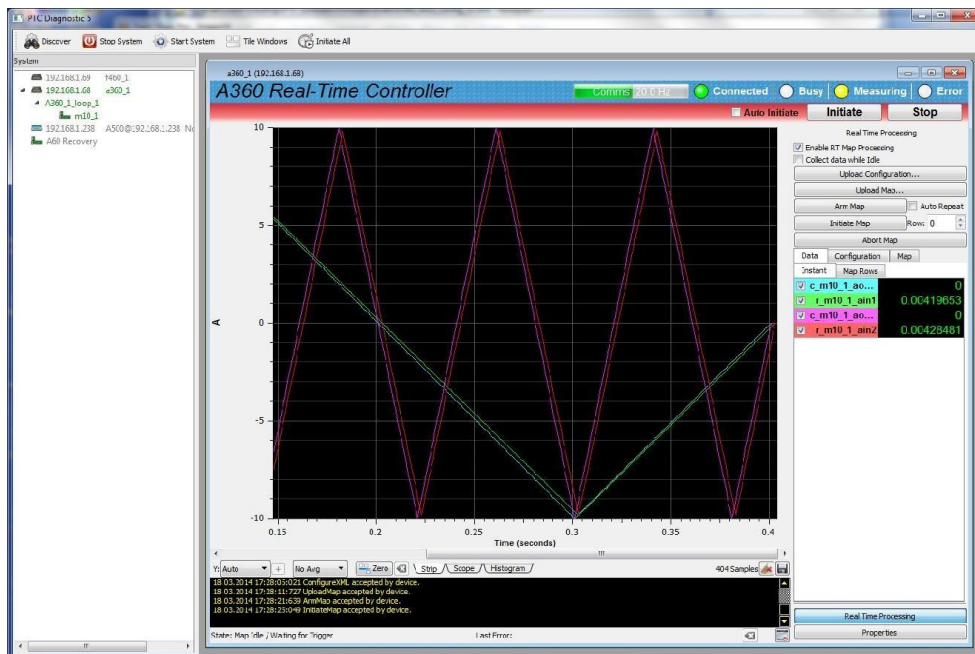




Figure 25. Display following map execution.

Other controls and displays on the Real-time Processing display have the following purposes

<b>Enable RT Processing</b>	This check box is set to enable the real0time processing function. It is set automatically if you load a valid xml file.								
<b>Collect data while idle</b>	If this box is checked, then the parameters you have defined in the <code>timeslicedatabase</code> will continue to be updated and displayed even after map execution has finished								
<b>Auto repeat</b>	If you check this box after loading valid xml and map files, the map will be repeated continuously.								
<b>Rows</b>	You can set the row in the map file that you wish to start from.								
<b>Abort map</b>	(Not used)								
<b>Data - instant</b>	Digital display of the parameters you have defined in the <code>timeslicedatabase</code> . The check boxes allow you to display or suppress traces on the graphic.  <table border="1" data-bbox="500 842 878 978"> <tr> <td><input checked="" type="checkbox"/> c_m10_1_ao...</td> <td>0</td> </tr> <tr> <td><input checked="" type="checkbox"/> r_m10_1_ain1</td> <td>0.00419653</td> </tr> <tr> <td><input checked="" type="checkbox"/> c_m10_1_ao...</td> <td>0</td> </tr> <tr> <td><input checked="" type="checkbox"/> r_m10_1_ain2</td> <td>0.00428481</td> </tr> </table>	<input checked="" type="checkbox"/> c_m10_1_ao...	0	<input checked="" type="checkbox"/> r_m10_1_ain1	0.00419653	<input checked="" type="checkbox"/> c_m10_1_ao...	0	<input checked="" type="checkbox"/> r_m10_1_ain2	0.00428481
<input checked="" type="checkbox"/> c_m10_1_ao...	0								
<input checked="" type="checkbox"/> r_m10_1_ain1	0.00419653								
<input checked="" type="checkbox"/> c_m10_1_ao...	0								
<input checked="" type="checkbox"/> r_m10_1_ain2	0.00428481								
<b>Data - rows</b>	As the map is executed, a table of timestamps and the parameters you have defined in the <code>database</code> builds up. The file save button  allows you to save the values as a csv file.								
<b>Configuration</b>	This tab displays the configuration you set up in the xml file in tree format.								
<b>Map</b>	This tab displays the map that has been loaded.								

## 14 Connecting Devices using EPICS

### 14.1 What is EPICS?

The Experimental Physics and Industrial Control System (EPICS, <http://www.aps.anl.gov/epics/>) is:

“A set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as particle accelerators, telescopes and other large scientific experiments. EPICS uses Client/Server and Publish/Subscribe techniques to communicate between the various computers. Most servers (called Input/Output Controllers or IOCs) perform real-world I/O and local control tasks, and publish this information to clients using the Channel Access (CA) network protocol. CA is specially designed for the kind of high bandwidth, soft real-time networking applications that EPICS is used for, and is one reason why it can be used to build a control system comprising hundreds of computers.”

Pyramid supplies an executable called IG2 which embeds an open source Channel Access Server from the EPICS community. This allows connection to front-end devices using the A360 via the Ethernet interface.

IG2 is configured for the devices you wish to connect using editable xml files. Once IG2 is running on a computer in your network, then any other computer can run a client program which can display and control the process variables for the devices. In the simple network in figure below, the process variables of an M10 attached to the A360 via fiber optics, are exposed to the network by the IG2 service running on a server computer. The M10 might typically be interfacing a power supply. One or more client computers can then access the values.

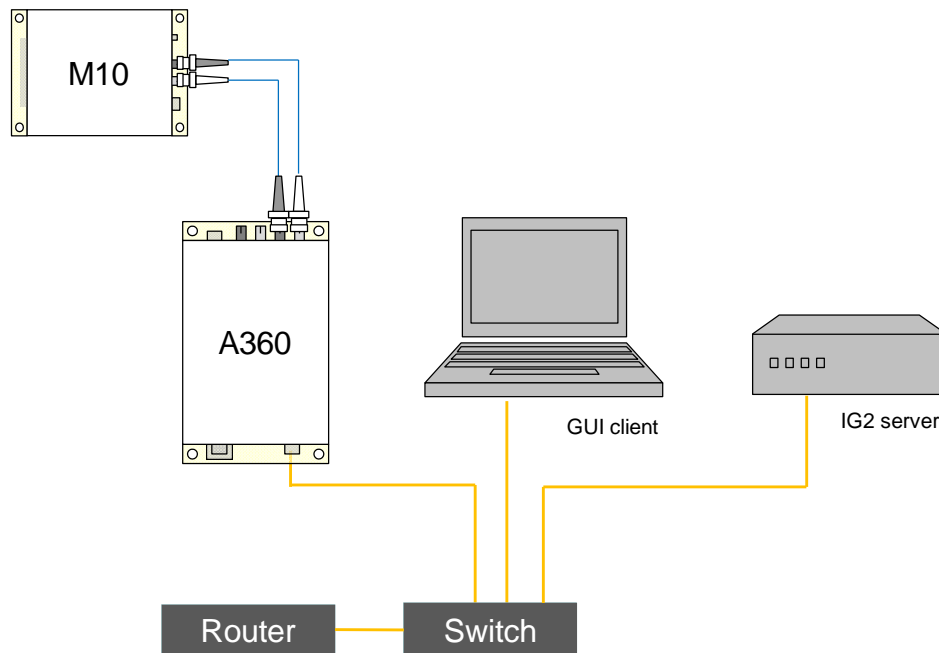


Figure 26. Simple example network for EPICS communications.

There is a wide range of client interfaces from the EPICS community, including interfaces for C++, C#, Java, Python, and Matlab™. The Control System Studio, or CS Studio, (<http://controlsystemstudio.github.io/>) is a set of ready-made tools built on Java and Eclipse (<http://www.eclipse.org/>) that allows users to get started with little or no programming required. There are various logging, plotting, post-processing and alarm point tools. A fully-featured “drag and drop” user interface editor (BOY) allows quite complex customized user interfaces to be created with minimum development time.

## 14.2 Installing and Configuring IG2

The IG2 package is available to users of Pyramid products. It is supplied as a zip file which should be de-compressed and the entire folder moved to the computer that will act as the server. The server and the user interface computer can be the same machine. The A360, the server and the user interface computer should be able to communicate with each other over your network.

In the folders you have saved, there is an xml file in the \service subdirectory that need to be edited to customize your particular setup. The format of the file is similar to the real-time processing configuration files described in section 12, but there are some differences reflecting the different function. IG2 looks for the file “system.xml” in the \service subdirectory to establish the configuration of the system. You can locate system.xml elsewhere than the default location, or give it a different name, in which case you need to specify the path and file name by means of an argument in the command line that launches IG2.

The system file comprises a header section on the xml schema, which does not need to change. Then comes a description of the user interface host computer, descriptions of the fiber optic loop

controller devices in your system and descriptions of the devices attached to loops. You don't have to describe every device and every input/output point that is present in your system, but only the ones that you expose in the system file will be visible to EPICS.

The simplified example in figure below shows the format. The example is for a fictitious power high voltage power supply called "ES Deflector 1\_56". An M10 device connected to the supply is configured with address one on loop 1 of the A360, which has IP address 192.168.1.68. One analog voltage output and two analog voltage inputs are exposed together with digital controls and readbacks for typical functions such as enable, reset, fault and so on. The analog voltages are scaled into physical units and their ranges are constrained.

The convention of "wires" for Pyramid device process variables, common to the real-time processing xml files, and the fixed names of those wires for each supported product, are described in the document "ig2\_scripting\_v#.#.pdf", where #.# is the document revision number. The document also describes in more detail how you can scale the values and how you can set up monitoring against tolerance bands.

The choice of a corresponding working name for each wire is up to the user; you may wish to choose something descriptive that is relevant to what you are measuring or controlling as shown in the example. We nevertheless recommend a naming convention that makes it clear whether a value is a readback or control (the prefixes c\_ and r\_ are used in the example), which particular device the value is associated with, and a number or letter to indicate the channel for multichannel devices.

```

1  <?xml version="1.0" encoding="iso-8859-1"?>
2  <system
3    xmlns="http://www.ptcusa.com"
4    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
5    xsi:schemaLocation="http://www.ptcusa.com A510.xsd" type="pyramid" >
6    <hosts>
7      <host ip="192.168.1.64" name="PTCE_Server" localhost="true" />
8    </hosts>
9
10   <loopcontrollers>
11     <loopcontroller type="A360" name="A360_1" ip="192.168.1.68" >
12       <loops>
13         <loop number="1" name="Slave_device_loop">
14           <boards>
15             <board type="M10" name="m10_1" address="1">
16               <channels>
17                 <channel name="r_ESD_1_56_kV" wire="analog_in_1" scaleB="10"/>
18                 <channel name="r_ESD_1_56_mA" wire="analog_in_2" scaleB="2"/>
19                 <channel name="c_ESD_1_56_kV" wire="analog_out_1" scaleB="10" limitLow="0" limitHigh="100" />
20                 <channel name="r_ESD_1_56_enabled" wire="digital_in_1" />
21                 <channel name="r_ESD_1_56_fault" wire="digital_in_2" />
22                 <channel name="r_ESD_1_56_local" wire="digital_in_3" />
23                 <channel name="c_ESD_1_56_enable" wire="digital_out_1" />
24                 <channel name="c_ESD_1_56_local" wire="digital_out_3" />
25                 <channel name="c_ESD_1_56_reset" wire="digital_out_4" />
26               </channels>
27             </board>
28           </boards>
29         </loop>
30       </loops>
31     </loopcontroller>
32   </loopcontrollers>
33
34   <interpreter>
35     <devices>
36       <epicscas type="epicscas" name="epics_server" />
37     </devices>
38   </interpreter>
39
40 </system>
41

```

length: 1456 lines: 41 Ln: 41 Col: 1 Sel: 0 | 0 Dos: Windows ISO 8859-1 INS

Figure 27. Example xml system configuration file for EPICS.

Once you have created and saved your system file, you can run the IG2 service executable. If the server has a display, you will see a console window that shows the connection process, then records subsequent control value changes sent to the devices via the A360. The names you declared will now be recognized as process variables by any EPICS-compatible client program.

As an example, the following screenshot shows a user interface for the “ES Deflector 1\_56” power supply, created in the CS Studio BOY OPI editor. The IG2 server and the GUI were running on a standard Windows PC.

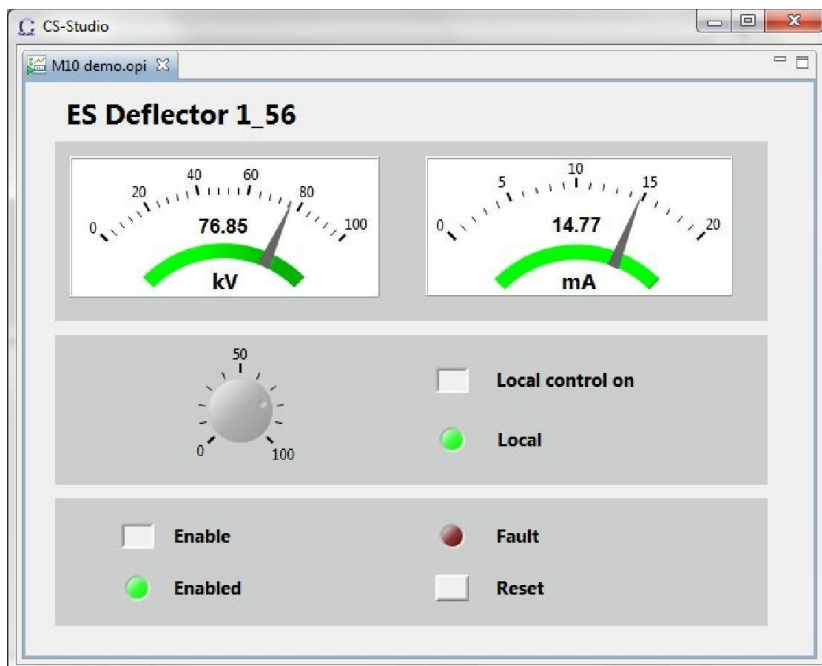


Figure 28. Example power supply user control created using CS Studio BOY.

## CAUTION



Don't try to control the devices connected via the A360 simultaneously from an EPICS client and from the PTC DiagnosticG2. The results will be confusing. In particular, if you attempt to run the IG2 service and PTC DiagnosticG2 on the same computer, the communications will conflict.

## 15 Connectors

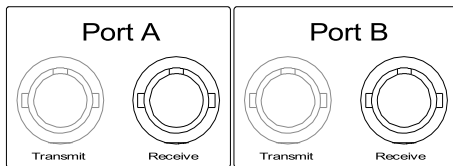
### 15.1 Front panel connectors

Four identical sets of connectors for the four channels.

#### 15.1.1 Fiber optic loop ports

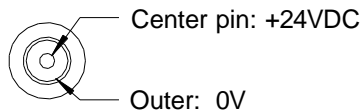
Two pairs of HFBR ST bayonet connectors suitable for 1 mm plastic or 200  $\mu\text{m}$  silica fiber. 664 nm (visible red) light.

Light casing = transmitter, dark casing = receiver.



#### 15.1.2 24 VDC power output

One 2.1 mm threaded jack. To mate with Switchcraft S761K or equivalent



### 15.2 Rear panel connectors

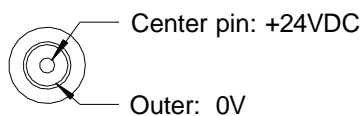
#### 15.2.1 Ethernet communications

RJ-45 jack. To mate with standard RJ-45 plug.

Auto MDIX facility - cable can be direct or crossover type.

#### 15.2.2 24 VDC power input

2.1 mm threaded jack. To mate with Switchcraft S761K or equivalent



#### 15.2.3 Ground lug

M3 threaded stud. To mate with M3 ring lug.

## 16 Controls and Indicators

### 16.1 Front panel controls

None.

### 16.2 Rear panel controls

#### 16.2.1 Reset button

Momentary push-button that forces a warm reset of the on-board processor. Also used during boot to force the default IP address (192.168.100.20).

### 16.3 Front panel indicators

None.

### 16.4 Rear panel indicators

Four green LEDs.



#### 16.4.1 Power

Green LED. 5 VDC and thus 24 VDC power is present.

#### 16.4.2 Initiated

Green LED. Not used on the A360.

#### 16.4.3 Active

Green LED. A360 processor has booted and is running normally.

#### 16.4.4 Com

Green LED. A host communication channel is active.

### **16.4.5 Ethernet**

Green LED. Ethernet commands are being received. The on state is stretched so that it can be seen. This LED does not illuminate for pings or if the A360.

### **16.4.6 Power up sequence**

On power-up, the Power LED illuminates and the remaining LEDs light in sequence while the A360 is booting. When a successful boot is completed, the Active LED will stay illuminated. When a connection to the host computer is established, the Comm LED will also illuminate.

### **16.4.7 RJ-45 indicators**

Green LEDs incorporated in the Ethernet connector show that a connection has been established (left hand LED) and that messages are passing (right hand LED).

## 17 Fault-finding

Symptom	Possible Cause	Confirmation	Solution
Unable to communicate via Ethernet	Incorrect IP address for A360 or host (not in the same subdomain).	Check settings of A360 host PC.	Use consistent IP addresses.
	DHCP server has assigned a new IP address.	Rediscover using PTC DiagnosticG2.	Update any configuration files that assume a particular address.
	Messages being blocked by Windows Firewall.	Disable firewall and recheck.	Either run with Firewall disabled, or set up permissions for the A360 traffic.
	Messages being blocked by anti virus software.	Disable anti-virus software	Set up allowed channels for A360 messages.
Unexpected changes to A360 connected devices	Another host is communicating with the A360.	Change IP address. Use a direct cable connection instead of a network.	Set up IP addresses and subnet masks to prevent conflicts.
Unable to connect devices on fiber optic loop	Fiber-connections crossed.	Check loops, ensure tx-rx sequence is correct.	Correct connections; use color-code fiber optics to aid connections.
	Duplicate addresses on a loop.	Check address settings	Ensure no duplicate settings.
	Real-time processing xml file does not expose the device.	Rediscover using PTC DiagnosticG2	Add device to xml file as required.
	Bad fiber optic cable.	Replace cable.	Re-terminate or replace cable as necessary.
	Firmware	Check releases for	Update firmware as

	incompatibility	the A360 and looped devices	necessary; consult Pyramid Technical Consultants or your supplier.
A360 loses power	Internal fuse open.	Check power LED. Disconnect power supply and any device using 24V output from A360, wait 5 minutes, re-try.	Locate source of excess current demand and fix.
	External 24V PSU foldback.	Check power LED. Disconnect any device using 24V output from A360, wait 5 minutes, re-try.	Locate source of excess current demand and fix.

## **18 Maintenance**

The A360 does not require routine maintenance, except to clear any dust accumulation in the fan filter.

There are no user-serviceable parts inside.

The A360 is fitted with 200mA and 1.1 amp automatically resetting positive temperature coefficient (PTC) fuse in the 24 VDC input and output respectively. No user intervention is required if a fuse operates due to overcurrent. The fuse will reset when the overcurrent condition ends.

## 19 Returns procedure

Damaged or faulty units cannot be returned unless a Returns Material Authorization (RMA) number has been issued by Pyramid Technical Consultants, Inc. If you need to return a unit, contact Pyramid Technical Consultants at [support@ptcusa.com](mailto:support@ptcusa.com), stating

- model
- serial number
- nature of fault

An RMA will be issued, including details of which service center to return the unit to.

## 20 Support

Manual and software driver updates are available for download from the Pyramid Technical Consultants website at [www.ptcusa.com](http://www.ptcusa.com). Technical support is available by email from support@ptcusa.com. Please provide the model number and serial number of your unit, plus relevant details of your application.

## **21 Disposal**

We hope that the A360 gives you long and reliable service. The A360 is manufactured to be compliance with the European Union RoHS Directive 2002/95/EC, and as such should not present any health hazard. Nevertheless, when your A360 has reached the end of its working life, you must dispose of it in accordance with local regulations in force. If you are disposing of the product in the European Union, this includes compliance with the Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC. Please contact Pyramid Technical Consultants, Inc. for instructions when you wish to dispose of the device.

## 22 Declaration of Conformity

### Declaration of Conformity

Issued by: Pyramid Technical Consultants, Inc.  
1050 Waltham Street, Lexington MA 02421, USA

The undersigned hereby declares, on behalf of Pyramid Technical Consultants, Inc. that the referenced product conforms to the provisions as listed. Refer to the document: *Extension of testing and analysis to the PTC product line, December 10, 2007*, and its continuations, and the *I400 Technical Construction File* for detailed testing information.

Product: A360 Dual Loop Controller

Year of initial manufacture: 2012

Applicable Directives: 73/23/EEC Low Voltage Directive:  
Laws for electrical equipment within certain voltage limits


89/336/EEC – EMC Directive:  
Laws relating to electromagnetic compatibility

Applicable Standards: IEC 610101:2002 (2<sup>nd</sup> Edition)  
UL 61010-1:2004  
EN 61326: 1997+A1:1998+A2:2001  
EN 55011:1998, A2:2002  
EN 61000-6-2:2001 – Electromagnetic Compatibility  
Generic Standard, Immunity for Industrial Applications

Issuing Agencies: Safety: TUV Rheinland North America.  
12 Commerce Rd, Newtown, CT 06470 USA

EMC: TUV Rheinland North America.  
12 Commerce Rd, Newtown, CT 06470 USA

Applicable Markings: TUV, FCC, CE

Authorized by:   
President, Pyramid Technical Consultants, Inc.

Date: 18 Feb 2013

The Technical Construction File required by these Directives are maintained at the offices of Pyramid Technical Consultants, Inc, 1050 Waltham Street, Lexington MA 02421, USA  
A copy of this file is available within the EU at the offices of Pyramid Technical Consultants Europe, Ltd, Suite 3 Unit 6-7  
Henfield Business Park, Henfield BN5 9SL, United Kingdom.

## 23 Revision History

The release date of a Pyramid Technical Consultants, Inc. user manual can be determined from the document file name, where it is encoded yymmdd. For example, B10\_UM\_080105 would be a B10 manual released on 5 January 2008.

<i>Version</i>	<i>Changes</i>
A360_UM_140319	First general release
A360_UM_250722	Updated address and removed outdated references