

## PWM Controller - Interface Specifications

Firmware version 1.39, webpage 1.26

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### Main Control Panel (PWM\_Controller.htm)

MiniPage | Presets | I/O Config | Network | Calibration | MotionCtrl | J-Systems

Pan 228.6° Tilt -9.2°

49.8% Focus Zoom 48.4%

2.793 Iris V

Auto Patrol enable:

OC Output 1:

OC Output 2:

2x Extend:  Out  In

12V Bus Level (V): 12.29

Temperature (°F): 82.3

Input 1

Input 2

OFF Relay

Pan 165.0° Tilt -1.2°

Focus 36.3% Zoom 46.9%

+ Joystick --> Pos Motor out  
Pos Motor --> Pos Pot V  
Pos Pot V --> Pos Position  
Pos means "increasing"

Firmware: v1.33 Webpage: 1.23 Copyright © 2013 J-Systems, Inc.

This interface is arranged like a traditional joystick controller and provides proportional control of the motors. This allows fast speeds for large movements and slow speeds for fine positioning. Arrow icons allow ultimate positing accuracy.

The control panel uses graphical control widgets and asynchronous messaging to provide interactive manual control of the remote Pan/Tilt Focus/Zoom camera controller.

- The joystick controls operate by clicking on the red 'knob' graphic and dragging it with the mouse. The response is weighted on an exponential curve so that at first very little motor output is commanded for a unit of movement. Further movement of the joystick generates exponentially greater motor output. The joystick returns to the center zero motor output position when released.
- Clicking on the 'Arrow' graphics will cause the controller to 'step' the target position by one encoder count per click - resulting in very fine positioning at high zoom.

- The linear slide indicators provide position feedback in user coordinate text values. They also show graphically where each axis is positioned within its full range of travel.
- The Toggle Switch controls change their value when you click on them. They can also change in response to events from the controller. For example, the switch will automatically reset itself to the 'Off' position when the pulse period is complete.

**Note:** The polarity conventions diagram above **must** be observed when connecting a motion platform to the controller or damage may occur!

- 'Open-loop' control mode is the Factory Default and should be used when connecting the controller to a motion platform for the first time. Only when all of the polarity conventions for all the axis have been met should the controller be set to 'Closed-loop' mode.
- If any physical axis moves opposite to the defined polarity then the motor wires for that axis should be reversed where they connect to the controller.
- If both the Pan/Tilt position indicators move opposite the defined polarity then the pot power leads to the controller should be reversed (same is true if both Focus/Zoom indicators move opposite).
- If just one slide position indicator moves opposite to the defined direction then the 'Reverse' flag for that axis should be changed in the MotionCtrl page.

[http://pwmcontroller/CP\\_Update.xml?PCmd=0&TCmd=0&FCmd=0&ZCmd=0&AOut=2048](http://pwmcontroller/CP_Update.xml?PCmd=0&TCmd=0&FCmd=0&ZCmd=0&AOut=2048)

[http://pwmcontroller/CP\\_Update.xml?Relay=Off&Patrol=Off](http://pwmcontroller/CP_Update.xml?Relay=Off&Patrol=Off)

[http://pwmcontroller/CP\\_Update.xml?OC1=On](http://pwmcontroller/CP_Update.xml?OC1=On)

[http://pwmcontroller/CP\\_Update.xml?OC2=Off](http://pwmcontroller/CP_Update.xml?OC2=Off)

[http://pwmcontroller/CP\\_Update.xml?Aux=Pos](http://pwmcontroller/CP_Update.xml?Aux=Pos)

The first form of the command is sent periodically to control the motors. The second form is sent only when the Relay or AutoPatrol controls are clicked. The fields are defined as follows:

<b>PCmd</b>	<b>Velocity control for the Pan Axis. Range: <math>\pm 31</math>, 0= No motion. NOTE: In Open-Loop mode, the values are sent directly to the motor drivers and correspond to 0-100% power. In Closed-Loop mode, the values are multiplied by the Joystick Gain (Motion Control page) and added periodically to the 'position setpoint' (in feedback units) to achieve a proportional velocity control. These commands are not allowed to interrupt a profile move in progress. This is different from the 'BUMP.xml?PCmd'. These motion commands normally have a timeout of ~2 seconds; ~0.5 seconds when the value is set to zero (for a fast stop).</b>
<b>TCmd</b>	<b>Motor Command to Tilt Axis. Range: <math>\pm 31</math>, 0= No motion.</b>
<b>FCmd</b>	<b>Motor Command to Focus Axis. Range: <math>\pm 31</math>, 0= No motion.</b>
<b>ZCmd</b>	<b>Motor Command to Zoom Axis. Range: <math>\pm 31</math>, 0= No motion.</b>
<b>Relay</b>	<b>'Off', 'On' = Energize relay.</b>
<b>Patrol</b>	<b>'Off', 'On' = Enable the AutoPatrol function.</b>
<b>OC1, OC2</b>	<b>'Off', 'On' = Open-Collector output is energized.</b>
<b>Aux</b>	<b>'Pos' = Last output was Positive polarity. 'Neg' = Last output was Negative polarity. 'Unk' = Last output was Unknown (power-up default).</b>
<b>AOut</b>	<b>Range (0-4096): 12-bit value of the D/A converter corresponds to 0~5.5V</b>

The controller responds to all the above commands by sending the following CP\_Update.xml page:

```
<?xml version="1.0" encoding="utf-8"?>
<CP_Update>
  <Input1>Off</Input1>
  <Input2>Off</Input2>
  <PanPos>122.8</PanPos>
  <TiltPos>-9.8</TiltPos>
  <FocusPos>61.7</FocusPos>
  <ZoomPos>54.2</ZoomPos>
  <CtrlMode>C</CtrlMode>
  <AutoPatrol>Off</AutoPatrol>
  <Relay>Off</Relay>
  <BattV>12.79</BattV>
  <Temp>23.6</Temp>
  <Dwell>56</Dwell>
  <ListState>2</ListState>
  <ListIndex>0</ListIndex>
  <OC1>Off</OC1>
  <OC2>On</OC2>
  <Aux>Unk</Aux>
  <AOut>4096</AOut>
  <PErr>3</PErr>
  <IsMoving>T</IsMoving>
  <CPStatusMsg>
    <Type>Info</Type>
    <Text></Text>
  </CPStatusMsg>
</CP_Update>
```

The sub-tags of <CP\_Update> are defined as follows:

<b>Input1</b>	<b>'Off', 'On' = Voltage applied to opto-isolated input 1 causes the LED indicator to turn green.</b>
<b>Input2</b>	<b>'Off', 'On' = Voltage applied to opto-isolated input 2 causes the LED indicator to turn green</b>
<b>PanPos</b>	<b>Position sensor data is scaled according to the Pan axis calibration and displayed on the linear slide indicator.</b>
<b>TiltPos</b>	<b>Position sensor data is scaled according to the Tilt axis calibration and displayed on the linear slide indicator.</b>
<b>FocusPos</b>	<b>Position sensor data is scaled according to the Focus axis calibration and displayed on the linear slide indicator.</b>
<b>ZoomPos</b>	<b>Position sensor data is scaled according to the Zoom axis calibration and displayed on the linear slide indicator.</b>
<b>CtrlMode</b>	<b>'C'= Closed-Loop control; required for the Presets and Patrol functions. 'O'= Open-Loop control; required for camera platform calibration.</b>
<b>AutoPatrol</b>	<b>'Off', 'On' = Auto Patrol mode operating. Note: Changing the state of the toggle switch from this status data does not cause a command to be issued as would happen if the user clicked on the control.</b>
<b>Relay</b>	<b>'Off', 'On' = Relay is energized. Note: Changing the state of the toggle switch from this status data does not cause a command to be issued as would happen if the user clicked on the control.</b>
<b>BattV</b>	<b>Voltage measured at the 12V input terminals. Range: 8.00-16.00 Volts, Accuracy: ±0.030V</b>
<b>Temp</b>	<b>Temperature in °F as measured by the optional on-board thermistor. Range: -40 to 200°F. Accuracy: ±2°F</b>
<b>Dwell</b>	<b>Range (0-65535): Number of seconds remaining remaining at the present Preset location before going to the next. Only valid when AutoPatrol is on.</b>
<b>ListIndex</b>	<b>Range: 0-19 When operating in automatic mode this index is used to select the table row corresponding to the camera position being displayed.</b>
<b>ListState</b>	<b>Range:(0-255) Updates every time a change is made to the PresetsList so the web page will know to refresh.</b>
<b>OC1, OC2</b>	<b>'Off', 'On' = Open-Collector output is energized.</b>
<b>Aux</b>	<b>'Pos'= Last output was Positive polarity. 'Neg'= Last output was Negative polarity. 'Unk' = Last output was Unknown (power-up default).</b>
<b>AOut</b>	<b>Range (0-4096): 12-bit value of the D/A converter corresponds to 0~5.5V</b>
<b>PErr</b>	<b>Range (+/-32767): Usually less than +/-10</b>
<b>IsMoving</b>	<b>'T'=True, 'F'=False</b>

The last sub-tab of <CP\_Update>, <CPStatusmsg> contains the following sub-tags:

**StatusType** *'Info'* - General information shown with no surrounding box or background color  
*'Warning'* - Displayed in a box with yellow background.  
*'Error'* - Displayed in a red box to indicate the last command was not executed correctly.  
*'Success'* - Displayed in a green box to indicate the command was completed properly.

**StatusText** Detailed description of the status condition.

**NOTE:** The message "Updated axis calibration." is displayed on the ControlPanel in response to a 'Set Calibration' action from the Calibration page. This is used to update the slide indicators.

<http://pwmcontroller/Bump.xml?PCmd=1>  
<http://pwmcontroller/Bump.xml?TCmd=-1>  
<http://pwmcontroller/Bump.xml?FCmd=1>  
<http://pwmcontroller/Bump.xml?ZCmd=-1>  
<http://pwmcontroller/Bump.xml?GoToP=1800&GoToT=155>  
<http://pwmcontroller/Bump.xml?GoToP=100&GoToT=200&GoToF=30&GoToZ=40>  
<http://pwmcontroller/Bump.xml?TimeOut=123>

The 'Bump' commands are similar to the joystick commands and are sent when the arrow icons are clicked. They increment the target feedback position setpoint for very fine positioning relative to the current position. These commands only work in 'Closed Loop' mode. Depending on MotionCtrl settings, it may take several seconds for the PID loop on an axis to respond to a single bump command.

If no parameters are passed then only the XML data will be returned. The optional message parameters are as follows:

**PCmd** Pan axis relative move distance (in feedback units). Range:  $\pm 127$ , 0= Stop motion. **NOTE:** This is a profile relative distance move - different from the 'CP\_Update.xml?PCmd, which is a velocity command'. These motion commands normally have a timeout of ~2 seconds; ~0.5 seconds when the value is set to zero.

**TCmd** Tilt axis feedback units. Range:  $\pm 127$ , 0= Stop motion.

**FCmd** Focus axis feedback units. Range:  $\pm 127$ , 0= Stop motion.

**ZCmd** Zoom axis feedback units. Range:  $\pm 127$ , 0= Stop motion.

**GoToP** The target coordinate in degrees for the Pan axis. Note: The GoTo() is an absolute move (in user-calibrated units) designed to utilize the full range of motion. This is different from the Bump() command, which is intended for very small, fine movements. The value is sent as an integer 10x the value of the desired coordinate (i.e. -23.4 --> -234 --> 360.0).

**GoToT** The target coordinate in degrees (10x) for the Tilt axis. Note: When Pan, Tilt axis targets are sent as one command, then Focus, Zoom remain un-changed.

**GoToF** Target coordinate in percentage (10x) for the focus axis. Range: 0-1000

**GoToZ** Target coordinate in percentage (10x) for the zoom axis. Range: 0-1000. When Pan, Tilt, Focus, Zoom are sent as one command then all axes are driven.

**TimeOut** Seconds that a move command will operate before stopping (10x). Range: 0-255, default is 20 (2.0 seconds). This value affects joystick operation, settle time after a GoTo, and settle time after a drift correction.

The controller response to the bump commands is a Bump.xml message such as:

```
<?xml version="1.0" encoding="utf-8"?>
<Bump>
  <CPStatusMsg>
    <Type>Info</Type>
    <Text>Jog Tilt -1</Text>
  </CPStatusMsg>
</Bump>
```

There is one more command issued by the Control Panel:

<http://pwmcontroller/Calibration.xml>

This command is sent when the control panel page first loads to setup the slide indicators. This command and its XML response data are explained fully in the later section on Calibration.

## Presets List / Patrol Setup (PresetsList.htm)

Close

Any camera position can be saved as a Preset in the list. In *Auto Patrol* mode the camera will move to each successive Preset that has its Patrol field checked.

Select a row and use the buttons to edit the Preset List

Insert
Delete
GoTo Preset
Update Coords

Preset Name	Patrol	Dwell	Out	Skip	Pan	Tilt
Front Door	P	15	N	0	40.0	-10.0
Back Door	P	20	R	4	120.0	10.0

Name	Patrol	Dwell	Output	Skip
<input type="text" value="Front Door"/>	<input checked="" type="checkbox"/>	<input type="text" value="15"/>	<input type="text" value="&lt;none&gt;"/>	<input type="text" value="0"/>
<span style="border: 1px solid gray; padding: 2px 10px;">Update Row</span>				

Input 1 Action	Input 2 Action
<input type="text" value="&lt;none&gt;"/>	<input type="text" value="&lt;none&gt;"/>

The controller can save up to 20 'pre-defined sets' of Pan/Tilt/Focus/Zoom position coordinates. All currently defined 'Presets' are displayed in the Presets List page above. Moving the mouse across the presets table will highlight each row in turn. Clicking on a highlighted row will select that row so it can be operated on by one of the five buttons.

The four buttons at the top of the screen can add, remove, move to, or update the position coordinates of any preset. The operation of each button is described in more detail below in the command section

The edit region in the middle of the screen can update the Name, Patrol flag, Dwell time, Output, or Skip of the selected preset when the Update button is pressed.

The edit region at the bottom of the screen configures the action to be taken when a signal is detected on each of the optically-isolated inputs. These indexes are automatically updated when Presets are Inserted/Deleted from the list to maintain the original selection unless the originally selected preset itself is deleted. At present the Trigger options are:

1. Do nothing.
2. Trigger the relay to pulse for the number of seconds specified by 'Pulse Seconds' on the IOConfig page.
3. GoTo to the selected camera Preset.

This panel operates in one of two different modes. In practice there is little difference between the modes other than the selected table row will change by itself occasionally when Auto-Patrol is active.

- *Manual mode:* The 'GoTo Preset' button will command the controller to drive the camera Pan/Tilt Focus/Zoom axes to any one of these pre-defined positions. The joystick controls on the main panel can also be used to manually reposition the camera as needed by the operator in real-time.
- *Auto-Patrol mode:* When the 'AutoPatrol' switch on the control panel is 'On' the controller will automatically move to the next Preset position that has its 'Patrol' flag set. The controller will maintain this position for a period of time defined by the 'Dwell' field and then move on to the next 'Patrol Position'. The controller will continue to loop thru the list as long as the 'AutoPatrol' switch is set. To edit camera presets without the inconvenience of having the selected item change, just set the AutoPatrol switch off.

<http://pwmcontroller/PatrolStatus.xml>

This command is sent to the controller periodically to query the status of the AutoPatrol function. The controller sends a PatrolStatus.xml page in response:

```
<?xml version="1.0" encoding="utf-8"?>
<PatrolStatus>
  <ListIndex>0</ListIndex>
  <ListState>1</ListState>
  <Dwell>23</Dwell>
  <AutoPatrol>Off</AutoPatrol>
</PatrolStatus>
```

The sub-tags of <PatrolStatus> are defined as follows:

- ListIndex** Range: 0-19 When operating in automatic mode this index is used to select the table row corresponding to the camera position being displayed.
- ListState** Range:(0-255) Updates every time a change is made to the PresetsList so the web page will know to refresh.
- Dwell** Range:(0-65535) Number of seconds remaining remaining at the present Preset location before going to the next. Only valid when AutoPatrol is on.
- AutoPatrol** 'Off', 'On' = Controller is operating in automatic mode and moving to successive presets with the 'Patrol' flag set.

In addition to the asynchronous PatrolStatus command above, the following commands are sent immediately when the user presses the corresponding command button:

```
http://pwmcontroller/PresetsList.xml?Action=I&Row=8
http://pwmcontroller/PresetsList.xml?Action=D&Row=3
http://pwmcontroller/PresetsList.xml?Action=G&Row=6
http://pwmcontroller/PresetsList.xml?Action=U&Row=6
http://pwmcontroller/PresetsList.xml?Action=S&Row=15&Name=16&Patrol=T&Dwell=4&Out=R&Skip=2
http://pwmcontroller/PresetsList.xml?Action=T&Trigger1=101&Trigger2=0
```

The parameters of these commands are as follows:

- Action** 'I' - Insert a new row in the table above the selected position. An error will be issued if there are already 20 rows defined.  
'D' - Delete the selected row from the table. An error will be issued if there is only 1 row left.  
'G' - The controller will 'GoTo' the selected row in the preset table.  
'U' - Update the position coordinates of the selected preset to reflect the current camera Pan, Tilt, Focus, & Zoom settings.  
'S' - Update the patrol settings for the selected preset table row.  
'T' - Configures the Trigger settings.
- Row** Range: 0-19 Is the selected row in the presets table..
- Name** Text description of the preset position. Maximum length is 16 characters, plus the '/0' terminator.
- Patrol** 'F', 'T' = Use this table item as a viewing position in the patrol function
- Dwell** Range: 0-255 The number of seconds to spend stationary at the selected preset before moving to the next patrol point.
- Out** 'R'= Pulse the relay output when preset position is reached.  
<reserved>'1'= Pulse the OC1 output " " "  
<reserved>'2'= Pulse the OC2 output " " "  
'N'= No action taken
- Skip** Range:(0-255) Nuber of complete patrol cycles to skip before pulsing the relay.
- Trigger1,**  
**Trigger2** '100'= No trigger action  
'101'= Trigger relay pulse of durations determined by 'Pulse Seconds' on the IOConfig page  
'0'-'19'= Trigger the controller to GoTo corresponding Preset (zero-based) from the PresetList.

The controller sends the PresetsList.xml page in response:

```
<?xml version="1.0" encoding="utf-8"?>
<PresetsList>
  <Preset>
    <Id>0</Id>
    <Name>1</Name>
    <Patrol>Off</Patrol>
    <Dwell>4</Dwell>
    <Out>R</Out>
    <Skip>2</Skip>
    <Pan>30.0</Pan>
```

```

        <Tilt>40.0</Tilt>
    </Preset>
    <Preset>
        <Id>1</Id>
        <Name>2</Name>
        <Patrol>On</Patrol>
        <Dwell>4</Dwell>
        <Out>N</Out>
        <Skip>0</Skip>
        <Pan>30.0</Pan>
        <Tilt>40.0</Tilt>
    </Preset>
    .
    . <-- Up to 20 Preset records
    .
    <Trigger1>101</Trigger1>
    <Trigger2>0</Trigger2>
    <StatusMsg>
        <Type>Info</Type>
        <Text></Text>
    </StatusMsg>
</PresetsList>

```

The XML data for <PresetsList> contains 1-20 <Preset> sub-tags which are defined as follows:

<b>Id</b>	<b>The zero-based index of the data in the controller array. Range: 0-19</b>
<b>Name</b>	<b>Text description of the Preset position. Range: 0-15 characters, including null-terminator.</b>
<b>Patrol</b>	<b>'Off', 'On'= Use this preset as a stop in the AutoPatrol function.</b>
<b>Dwell</b>	<b>Number of seconds for AutoPatrol to stay at this preset location before moving to the next.</b>
<b>Out</b>	<b>'R'= Pulse the relay output when preset position is reached. &lt;reserved&gt;'1'= Pulse the OC1 output " " " &lt;reserved&gt;'2'= Pulse the OC2 output " " " 'N'= No action taken</b>
<b>Skip</b>	<b>Range:(0-255) Nuber of complete patrol cycles to skip before pulsing the relay.</b>
<b>Pan</b>	<b>The Pan axis coordinate of this preset record.</b>
<b>Tilt</b>	<b>The Tilt axis coordinate of this preset record.</b>

The sub-tags <Input1>, and <Input2> are included here to build the "Trigger" option menu. The tags are defined as:

<b>Input1,</b>	
<b>Input2</b>	<b>'100'= The &lt;None&gt; option will be selected. '101'= The &lt;Pulse Relay&gt; option will be selected. '0'-'19'= The corrsponding Preset from the PresetList will be selected.</b>

The last sub-tag of <PresetsList>, <StatusMsg>, is common across multiple pages and its sub tags are described as follows:

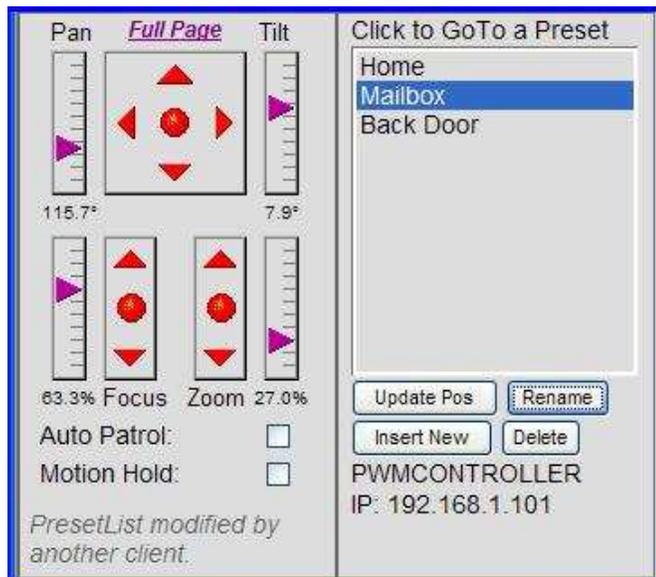
```

<StatusMsg>
    <Type>Info</Type>
    <Text></Text>
</StatusMsg>

```

<b>StatusType</b>	<b>'Info' - General information shown with no surrounding box or background color 'Warning' - Displayed in a box with yellow background. 'Error' - Displayed in a red box to indicate the last command was not executed correctly. 'Success' - Displayed in a green box to indicate the command was completed properly.</b>
<b>StatusText</b>	<b>Detailed description of the status condition.</b>

## Mini Control Page (MiniPage.htm)



Combines the most-commonly-used portions of the MainControl Panel and the PresetsList into a single page. This page has two divisions that will tile either horizontally or vertically, depending on how the window is resized to most effectively share screen real-estate with other applications on the user's monitor.

The MiniPage uses the same commands and XML status messages as the corresponding MainControlPage and PresetsList page.

## I/O Port Configuration (IOConfig.htm)

Close

This page allows the configuration of the board's I/O device settings.

Serial rate (baud):	<input type="text" value="2400"/>
Serial Protocol:	<input type="text" value="Pelco D"/>
Serial Device ID:	<input type="text" value="1"/>
Relay Pulse Seconds:	<input type="text" value="3"/>
Pan axis position input:	<input type="text" value="Analog potentiometer"/>
Tilt axis position input:	<input type="text" value="Analog potentiometer"/>
Pan/Tilt base orientation:	<input type="text" value="Base-Down"/>
<input type="button" value="Save Configuration"/>	

OC Output 1 Name	<input type="text" value="OC Output 1"/>
OC Output 2 Name	<input type="text" value="OC Output 2"/>
<input type="button" value="Set OC Names"/>	

Configures I/O port and protocol settings for the controller.

When the 'Save Configuration' button is pressed the controller validates the data and stores it into EEPROM.

<http://pwmcontroller/protect/IOConfig.xml?Port=1&Baud=3&Protocol=1&ID=0&PulseSec=30&PanE=A&TiltE=P>  
<http://pwmcontroller/protect/IOConfig.xml?OC1Name=Shutter Control&OC2Name=Film Advance>

The command parameters are as follows:

**Baud**     '1'= 2400  
               '2'= 4800  
               '3'= 9600

**Protocol**   '1' = Pelco D

**ID**           Range: (1-255)

**PulseSec**   Range:(1-65535) Duration of pulse in seconds

**PanE**        Position input device for the Pan axis.  
               'A'=Analog potentiometer 'P'=PWM-output encoder

**TiltE**       Position input device for the Tilt axis

**Orient**      Orientation of the Pan/Tilt head:  
               'U'= Base-Up 'D'= Base Down

**OC1Name**    Size (15 Char): Name displayed on ControlPanel for OC1.

**OC2Name**    Size (15 Char): Name displayed on ControlPanel for OC2.

The controller sends the IOConfig.xml page in response:

```
<?xml version="1.0" encoding="utf-8"?>
<IOConfig>
  <Baud>3</Baud>
  <Protocol>1</Protocol>
  <ID>0</ID>
  <PulseRelay>Off</PulseRelay>
  <PulseSec>150</PulseSec>
  <PanE>A</PanE>
  <TiltE>P</TiltE>
  <Orient>D</Orient>
  <OC1Name>Shutter Control</OC1Name>
```

```
<OC2Name>Film Advance</OC2Name>
<StatusMsg>
  <Type>Info</Type>
  <Text></Text>
</StatusMsg>
</IOConfig>
```

## Protected-Access Pages



Configuration pages that have the potential to disrupt operation of the controller are grouped together in the `/protect/` folder and require a username and password to access. These are the *Network Configuration*, *Dynamic DNS*, and *Calibration* pages. For now *User Name* = *admin*, and *Password* = *admin*.

## Axis Calibration (Calibration.htm)

Close

Each limit of each axis can be calibrated independently. To calibrate a limit:

1. Manually drive each axis to its calibration limit.  
*It may be necessary to set 'Set Mode' to Open-loop control.*
2. Enter the position coordinate to display for that limit.
3. Press the 'Set Calibration' button to save the calibration.

Description	Cal Position	Fbk Reading
Pan Axis Min	0.0	200
Pan Axis Max	360.0	800
Tilt Axis Min	-40.0	401
Tilt Axis Max	40.0	626
Focus Axis Min	0.0	200
Focus Axis Max	100.0	800
Zoom Axis Min	0.0	200
Zoom Axis Max	100.0	800

Description
Cal Position
Set Calibration

Closed-loop
 Open-loop
Set Mode

Reset board to factory defaults.
Reset Now

The controller can operate up to (4) axis of motion. These are nominally the Pan, Tilt, Focus, and Zoom axis for a camera, but can be used for other actions with comparable hardware. Each axis consists of a 12VDC motor pulling less than 1Amp on average, with a peak current of 5Amps. Feedback is typically with a potentiometer.

The position outputs are shown in user-defined units such as degrees, inches, or %. In order to output these units correctly the user must first calibrate the controller with the actual hardware it will be connected to in the field.

Calibration consists of moving each axis to a calibration point, entering the user coordinate of that point, and pressing the 'Set Calibration' button. These calibration points should be chosen to be near the full limits of travel and the user coordinates of these points should be well defined and repeatable. Each end of each axis must be calibrated separately, but do not have to be done in any particular order.

The axis would normally only be calibrated when the controller is connected to a mechanical platform for the first time. If, say, a Tilt sensor were to be replaced in the field then it would be necessary to re-calibrate both the Min and Max Positions of the Tilt axis for the new sensor.

**Warning:** The 'Reset board to factory defaults' option affects not only the calibration settings, but the Control Pane, Presets List, and MotionCtrl settings as well. To prevent an inadvertent reset the checkbox must be checked prior to clicking the reset button. Any other operation on the page clears the checkbox.

**Note:** The Calibration.xml file is not in the /protect/ folder because it is needed by the main page to scale the position indicators and has to be accessed without a password.

<http://pwmcontroller/Calibration.xml>  
<http://pwmcontroller/Calibration.xml?Action=C>  
<http://pwmcontroller/Calibration.xml?Action=O>  
<http://pwmcontroller/Calibration.xml?Action=R>  
<http://pwmcontroller/Calibration.xml?Action=U&Row=1L&Position=-25>

If no parameters are passed then only the XML data will be returned. The optional message parameters are as follows:

<b>Action</b>	'C' - Sets the controller for Closed-loop control. 'O' - Sets the controller for Open-loop control. 'R' - Reset the board configuration values to factory defaults. 'U' - Update the data in the selected preset table row.
<b>Row</b>	Values: '0L', '0H', '1L', '1H', '2L', '2H', '3L', '3H'
<b>Position</b>	The user-coordinate for the calibration position. Note: The value is sent as an integer 10x the value of the desired coordinate(i.e. -234 --> -23.4, 3600 --> 360.0).

The controller sends the Calibration.xml page in response:

```
<?xml version="1.0" encoding="utf-8"?>
<Calibration>Pul
  <Axis>
    <Id>0L</Id>
    <CalLimit>0.0</CalLimit>
    <FbkValue>0</FbkValue>
  </Axis>
  <Axis>
    <Id>0H</Id>
    <CalLimit>360.0</CalLimit>
    <FbkValue>1023</FbkValue>
  </Axis>
  .
  . <-- 3 more Pairs of Axis tags(1L,1H,2L,2H,3L,3H)
  .
  <CtrlMode>C</CtrlMode>
  <OC1Name>Shutter Control</OC1Name>
  <OC2Name>Film Advance</OC2Name>
  <StatusMsg>
    <Type>Info</Type>
    <Text></Text>
  </StatusMsg>
</Calibration>
```

The XML data tags for <Calibration> contains eight <Axis> tags, each containing the following sub-tags:

<b>Id</b>	'0L' = Pan axis Lower calibration point. '0H' = Pan axis Higher calibration point. '1L' = Tilt axis Lower calibration point. '1H' = Tilt axis Higher calibration point. '2L' = Focus axis Lower calibration point. '2H' = Focus axis Higher calibration point. '3L' = Zoom axis Lower calibration point. '3H' = Zoom axis Higher calibration point.
<b>CalLimit</b>	User coordinates of the calibration endpoint. Range: 0.0-999.9
<b>FbkValue</b>	Position sensor reading taken at the calibration endpoint. Range: 0-1023

Next are the following sub-tags of the <Calibration> record:

<b>CtrlMode</b>	'C' = Closed-Loop control; required for the Presets and Patrol functions. 'O' = Open-Loop control; required for camera platform calibration.
-----------------	---

The last sub-tab of <Calibration>, <StatusMsg>, is common across multiple pages and is described in the Presets List section of the manual.

## Motion Control (MotionCtrl.htm)

Close

The controller operates four DC motor axis with PID feedback control. This table below contains the critical PID operating parameters.

Name	Enb	Rev	JS	MaxV	Accel	Kp	Ki	Kd
Pan	E		0.039	3.000	1.000	0.695	0.004	0.000
<b>Tilt</b>	<b>E</b>		<b>0.008</b>	<b>1.000</b>	<b>0.664</b>	<b>1.500</b>	<b>0.008</b>	<b>0.000</b>
Focus			0.063	6.668	1.656	0.297	0.008	0.000
Zoom		R	0.055	6.000	1.660	0.500	0.008	0.000

Axis Name:

Closed-Loop control:  Enable

Reverse position sensor:  Reverse

Joystick Gain:

Maximum Velocity:

Acceleration:

Proportional Term Kp:

Integral Term Ki:

Derivative Term Kd:

Pulse axis and record impulse response

The four axis operate under closed-loop PID control. The control constants can be edited by selecting a row, changing values, and clicking 'UpdateRow'. To aid in tuning the axes the 'PulseNow' button will cause a ~5% step change on the selected axis and plot the impulse response over 3 seconds. The data can be downloaded and plotted in an Excel graph.

**Warning:** The best bet is to leave this page strictly alone. Changing the settings on this page can make the motion controller unstable.

<http://pwmcontroller/protect/MotionCtrl.xml>

<http://pwmcontroller/protect/MotionCtrl.xml?Pulse=1>

<http://pwmcontroller/protect/MotionCtrl.xml?id=1&Enb=T&Rev=F&JGain=12&MaxV=256&Accel=169&Kp=256&Ki=0&Kd=0>

If no parameters are passed then only the XML list is returned - used to initialize the web page

**Pulse** Values: '0', '1', '2', '3' - The Axis that gets pulsed.

**Id** Values: '0', '1', '2', '3' - The Axis values that get updated.

**Enb** 'F','T'= Enable Closed-loop control on this axis. A disabled axis can still be operated on Open-loop mode.

**Rev** 'F','T'= Reverse position sensor.

**JGain** Translates Joystick values to axis Velocity commands \* 256.

**MaxV** The peak velocity allowed \* 256. (Must be less than hardware limit)

**Accel** Acceleration used for ramp up / ramp down of velocity \* 256. (Must be less than hardware limit)

**Kp** PID Proportional term \* 256.

**Ki** PID Integral term \* 256.

**Kd** PID Derivative term \* 256.

The controller sends the MotionCtrl.xml page in response:

```
<?xml version="1.0" encoding="utf-8"?>
<MotionCtrl>
```

```

    <Axis>
      <Id>0</Id>
      <Enb>On</Enb>
      <Rev>Off</Rev>
      <JGain>12</JGain>
      <MaxV>256</MaxV>
      <Accel>169</Accel>
      <Kp>256</Kp>
      <Ki>0</Ki>
      <Kd>0</Kd>
    </Axis>
    .
    . <-- 3 more Axis tags
    .
    <StatusMsg>
      <Type>Info</Type>
      <Text></Text>
    </StatusMsg>
  </MotionCtrl>

```

The XML data tags for <MotionCtrl> are defined as follows:

<b>Axis</b>	<b>One complete record is sent for each controller axis. The sub-tags are described as follows:</b>
<b>Id</b>	'0'= Pan axis Lower calibration point. '1'= Tilt axis. '2'= Focus axis. '3'= Zoom axis.
<b>Enb</b>	'Off','On'= Closed-loop control enabled.
<b>Rev</b>	'Off','On'= Reverse position sensor. (Ascending<-->Decending)
<b>JGain</b>	Higher values will give faster motion for a given amount of joystick movement (limited by the physical speed of the mechanism) * 256
<b>MaxV</b>	Speed limit for the axis * 256.
<b>Accel</b>	Acceleration used to ramp up / ramp down velocity * 256.
<b>Kp</b>	PID Proportional gain term * 256
<b>Ki</b>	PID Integral gain term * 256
<b>Kd</b>	PID Derivative gain term * 256

## Network Configuration (NetConfig.htm)

**Close**

This page allows the configuration of the board's network settings.

MAC Address:	<input type="text" value="00:50:C2:B4:30:00"/>
Host Name:	<input type="text" value="PWMCONTROLLER"/>
Port:	<input type="text" value="80"/>
Admin Password:	<input type="password" value="•••••"/>
Re-enter Password:	<input type="password" value="•••••"/>
	<input checked="" type="checkbox"/> Enable DHCP
IP Address:	<input type="text" value="10.0.0.5"/>
Gateway:	<input type="text" value="10.0.0.1"/>
Subnet Mask:	<input type="text" value="255.255.255.0"/>
Primary DNS:	<input type="text" value="75.75.75.75"/>
Secondary DNS:	<input type="text" value="75.75.76.76"/>
	<input type="button" value="Save Config"/>

**CAUTION:** Incorrect settings may cause the board to lose network connectivity.

Configures the network settings for the controller. If the 'Enable DHCP' box is checked then only the HostName and MAC Address fields get sent; otherwise all the data fields get sent.

**NOTE:** To discourage changing the MAC address the field is initially disabled until a mouse right-click is detected on the page.

When the 'Save Config' button is pressed the controller validates the data, stores it into EEPROM, and performs a self-reset after displaying the Reboot.htm page (*see below*).

<http://pwmcontroller/protect/NetConfig.htm?dhcp=1&host=PWMCONTROLLER%20%20&mac=00%3A50%3AC2%3AB4%3A30%3A00&pwd1=http://pwmcontroller/protect/NetConfig.htm?dns1=192.168.0.1&dns2=205.171.3.25&gw=192.168.1.1&host=PWMCONTROLLER&ip=192.168.1>

The command parameters are as follows:

<b>mac</b>	<b>MAC Address</b>
<b>host</b>	<b>HostName to assign to the controller so you can browse to it using http://'HostName'//</b>
<b>dhcp</b>	<b>'0', '1' = Checked = Use DHCP to obtain IP address.</b>
<b>pwd1</b>	<b>Admin password used to access protected pages.</b>
<b>pwd2</b>	<b>Admin password (must match pswd1 to change).</b>
<b>ip</b>	<b>IP Address</b>
<b>gw</b>	<b>Gateway</b>
<b>sub</b>	<b>Subnet Mask</b>
<b>dns1</b>	<b>Primary DNS</b>
<b>dns2</b>	<b>Secondary DNS</b>

Example Reboot.htm page:

## Reboot In Progress...

Your settings were successfully saved, and the board is now rebooting to configure itself with the new settings.

**Your board is now located at:**

<http://PWMCONTROLLER/>

### Reconnection Instructions

**1. Did you change the hostname, IP or MAC address?**

It is necessary to clear the address caches in your web browser and OS. From the command prompt in Windows, enter "nbtstat -R" to clear the hostname cache, close your current web browser, open a new web browser, and then try to access the web address above.

**2. Did you try the IP address?**

Try accessing the board directly at the IP address shown using the 'Find PWM\_Controller' application. If this fails, then the IP address you set is not reachable. Try the step below.

**3. Still not working?**

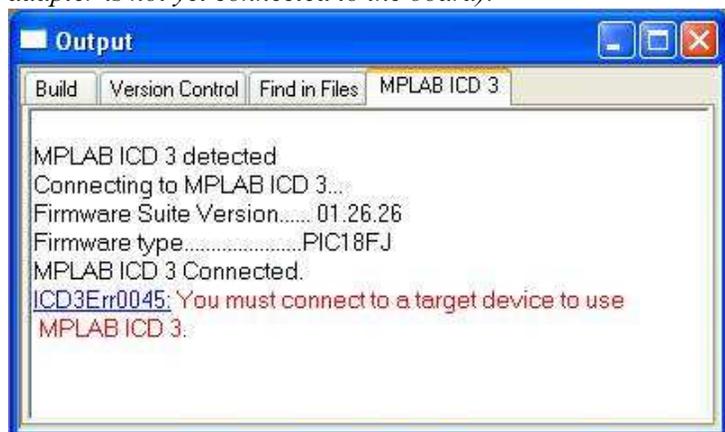
You can restore compile-time settings by clearing the board's EEPROM. Short the two pins on the thermistor connector, Rt1 while powering-up the board.

## Network Bootloader

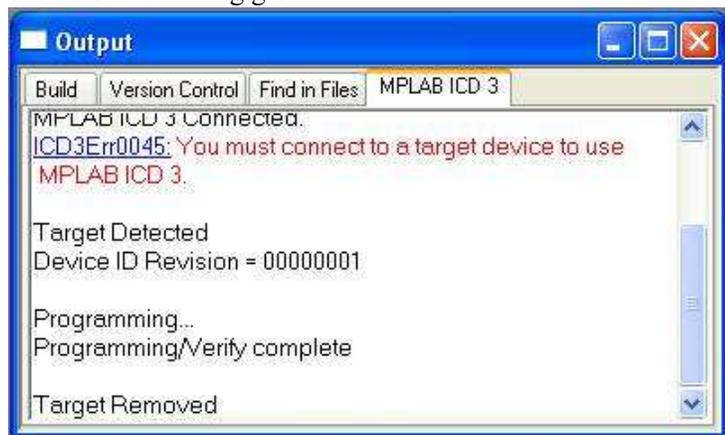
The Network Bootloader is an program stored in a separate section of FLASH memory from the controller Firmware application. Its sole purpose is to run immediately after a system reboot and check for a Firmware update request. If no request is detected after a few seconds it passes control to the resident Firmware program.

The Bootloader itself is programmed as follows:

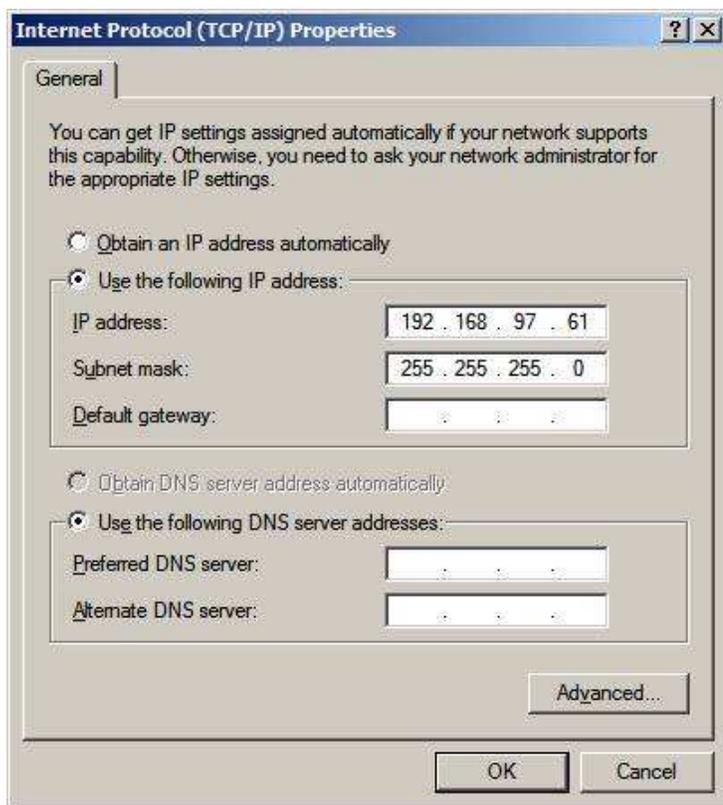
1. Make sure the programmer and 6-Pin programming adapter are connected and run the MPLAB IDE software.
2. Under **Configure | Select Device...**, select 'PIC18F67J60'. You should see PIC18F68J60 displayed on the status bar at the bottom of the window.
3. Under **Programmer | Select Programmer**, select 'MPLAB ICD3' or whatever programmer you are using. In the Output window you should see a message similar to the one below (*the error message is because the programming adapter is not yet connected to the board*).



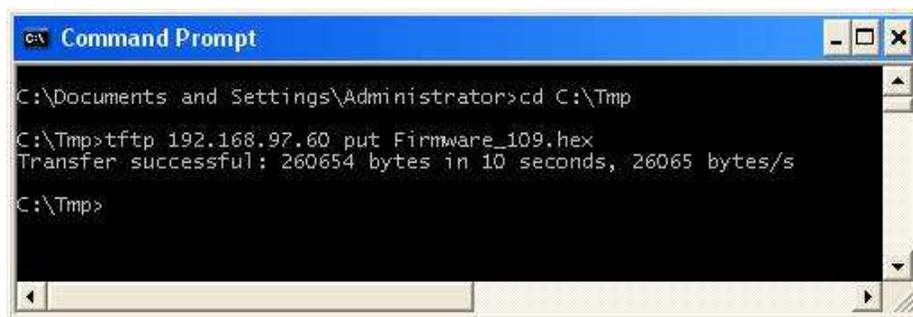
4. Under **File | Import...**, select 'Internet Bootloader.hex' and click 'Open'. You should see a message confirming the file was loaded in the Output window.
5. Connect the programming header to the J4 port on the board; being sure to align the Pin1 markers. When the header is properly aligned the message "Target Detected" will be shown in the Output box.
6. Select **Programmer | Program** to start the processes. The message 'Programming/Verify complete' will indicate that the processes is complete and the header can be removed from the board. The green LED on the Ethernet port should start blinking green.



The first version of Firmware is loaded thru the network during manufacture by setting the following TCP/IP network properties on the programmer PC:



Load the Firmware using the TFTP protocol to address 192.168.97.60 as shown:



Don't forget to reset your PC network configuration. The controller will now negotiate a network address using DHCP and should respond to the DNS name "pwmcontroller". The 'Device Finder' utility can also query the controller for its IP address.

Once this first Firmware is loaded any field updates can be performed more easily using the instructions in the next section.

## **Firmware Update**

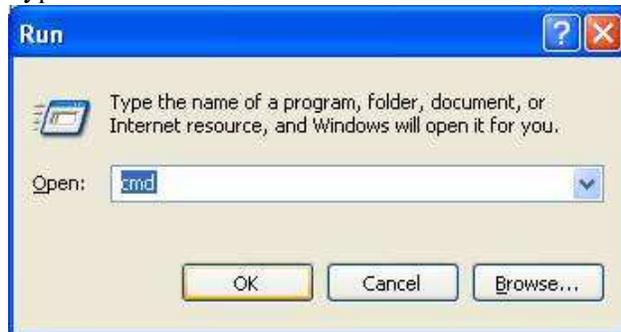
If you should purchase a new feature in your PWM\_Controller firmware, or if J-Systems, Inc. should release a new version of firmware to improve the quality of your controller, the following instructions will let you update your controller firmware directly from your PC.

These instructions assume you're using a PC with Microsoft Windows XP installed. Different operating systems will vary somewhat from the instructions below:

1. Open the Command Prompt Window:



2. Type "Cmd" and hit 'Enter':



3. Change to the directory which hold your .hex file (in this case C:/Tmp)

4. Enter "tftp pwmcontroller put Firmware.hex" (you may need to change the network address and .hex filename if they differ from the example)



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>cd \tmp

C:\Tmp>tftp pwmcontroller put Firmware.hex
Transfer successful: 248701 bytes in 14 seconds, 17764 bytes/s

C:\Tmp>_
```

It may also be necessary to upload a new set of web pages to the controller. This is a separate operation from updating the firmware.

1. Open a browser window to 'http://pwmcontroller/mpfsupload', browse to the pre-compiled web pages file, and press 'Upload':

