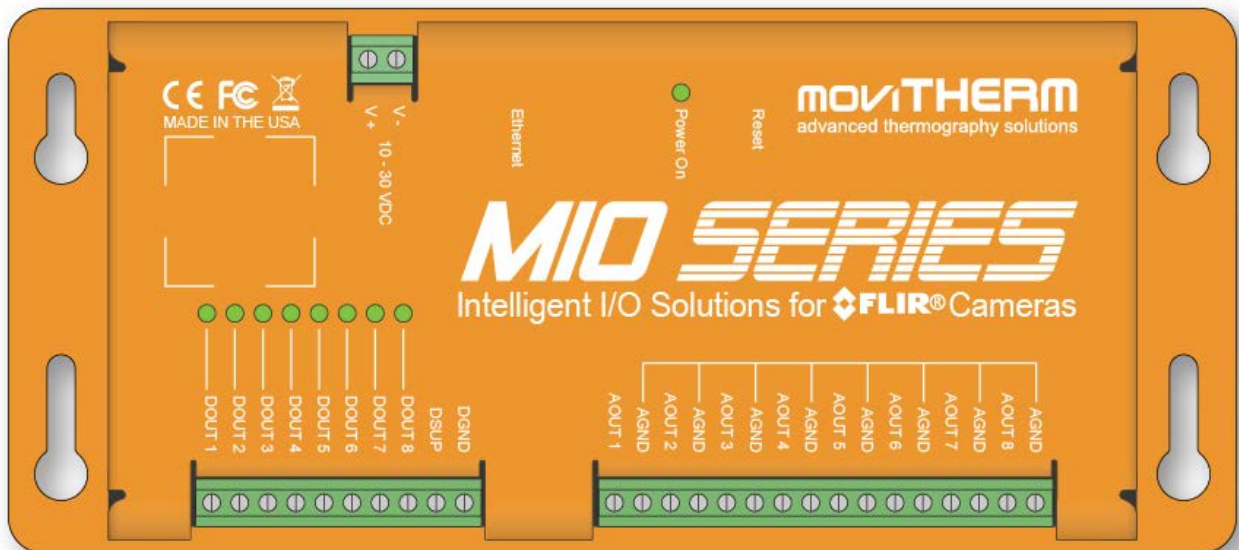


MoviTHERM MIO Series of Intelligent I/O Modules

Intelligent I/O Module for FLIR® AX8 Cameras



User Manual

Revision 1.4

Support

Thank you for selecting MoviTHERM Products.

For product updates and web support, visit:

<http://www.movitherm.com>

General Disclaimer

MoviTHERM temperature monitoring solutions (hardware and software) are intended for supplemental thermal monitoring. The device described in this document is only intended to alert human operators of an emergency situation. The MoviTHERM device is not intended as a substitute for prudent fire prevention practices and conventional fire prevention equipment, nor is it a substitute for life and property insurance. The MoviTHERM device must be installed and serviced by qualified professionals who, along with this documentation package, will provide information about the capabilities and limitations of the device. While generally very reliable, the device may not work under all conditions such as (but not limited to) interruptions to power, component failure, and/or other unanticipated operational conditions that were not present during installation, testing and validation. When correctly installed and maintained, the MoviTHERM device explained in this document should reliably provide years of trouble-free service. All MoviTHERM systems and devices must be used in combination with redundant fire detection and response systems.

Compliance

The MIO I/O module is CE/FCC compliant. Refer to the MoviTHERM MIO Compliance documentation supplied with the device.

Trademarks

FLIR, the FLIR logo, and all FLIR product names referenced in this document are trademarks and/or registered trademarks of FLIR Systems, Inc. and/or its subsidiaries.

Information is subject to change without notice. ©2015 MoviTHERM - All rights reserved.

Table of Contents

1	Foreword.....	1
2	Device Overview	2
3	Unpacking	2
4	Connecting the MIO I/O Module	3
5	Specifications	5
6	System Installation and Set-up	5
6.1	Configuration Procedure.....	6
6.1.1	IP Configuration	7
6.2	Preparing MIO for Configuration	8
6.3	Assigning Actions to Camera Regions: The MIO Controller Utility	8
6.3.2	The Camera Settings Tab	14
6.3.3	The Debug Tab	21
6.4	Recovery Mode	22
6.4.1	Password Reset.....	24
7	Operations	24
7.1	I/O Connections.....	24
7.1.1	Digital Output Pin Definitions	25
7.1.2	Analog Output Pin Definitions	25
8	Troubleshooting Common Issues	28
9	Appendix A: Default Settings	30
10	Appendix B: Technical Specifications.....	30
10.1	Absolute Maximum Ratings	30
10.2	Operating Specifications	30

1 Foreword

Congratulations on your purchase of the MoviTHERM MIO Series of Intelligent I/O Module. We appreciate your business and want to make sure that your installation is successful. This manual provides important information for installation, setup, configuration and care of your new product.

PLEASE MAKE SURE TO READ THE ENTIRE MANUAL CAREFULLY BEFORE OPERATING THIS DEVICE.



Whenever you see the symbol to the left, please pay special attention. This is a warning symbol. Carefully consider all warnings in this document in order to prevent any mistakes.



The blue light bulb and checkmark symbol indicates a useful tip or information.

We invite any suggestions that you might have for improving our products or this user manual. Please feel free to contact us at any time with your questions, suggestions or concerns:

MoviTHERM – Advanced Thermography Solutions

15540 Rockfield Blvd., Suite C110

Irvine, CA, USA

Phone: +1 949.699.6600

Fax: +1 949.699.6601

Email: info@movitherm.com

Website: <http://www.movitherm.com>

Twitter: www.twitter.com/movitherm

2 Device Overview

This User's Guide describes how to install, configure, and use the **MoviTHERM MIO Intelligent I/O** device. For detailed device specifications, refer to the specifications section at the end of this document.

The **MoviTHERM MIO Intelligent I/O** device provides TCP/IP connectivity for up to 7 cameras over 100Base-T Ethernet connections. Each unit provides up to 8 channels of isolated, loop-powered analog (4-20mA) outputs, and up to 8 solid state (24VDC) relay outputs.

3 Unpacking

The MoviTHERM MIO Intelligent I/O device or module ships in a custom printed cardboard box, as shown in the photo below.



After removing the device from the packaging, inspect for damage that may have occurred during shipping. Damaged devices should not be put into service. Contact your distributor and/or MoviTHERM immediately if the device appears damaged in any way. If the damages occurred during shipping, please file a claim with your shipping company.

4 Connecting the MIO I/O Module

Inspect the device to locate the various ports and connectors. (See Figure 1.)

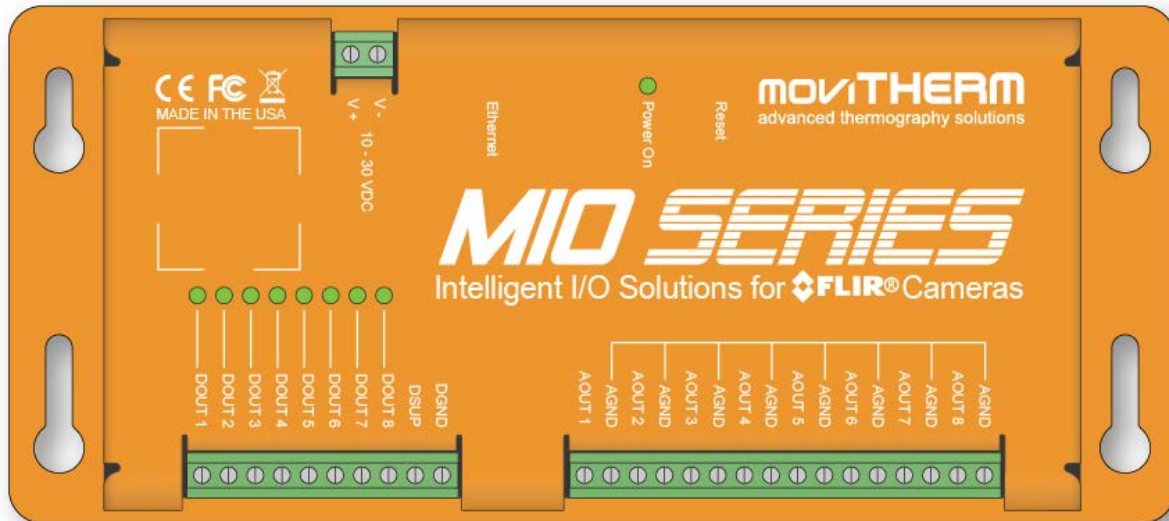


Figure 1: MIO Device Connections

The device is powered using a 24VDC power supply. Under full load conditions, the unit draws about 0.3A (7W). This does not count the current needed to supply the digital outputs. The digital outputs can source 0.5A each, but shall not exceed 1.5A total for all outputs. A power supply does not come included with the MIO module. However, it is available as an accessory. The provided power source or supply shall be regulated and stabilized to assure reliable performance.

The power terminals shown in **Figure 1** must be connected to an industrial 24VDC power supply. The unit will also work with a 12VDC supply. Its input voltage needs to be between 10VDC and 30VDC. Please connect the positive lead to the screw terminal marked “V+” and the negative or ground lead to the terminal marked “V- “. Please make sure not to reverse the polarity. The unit has a reverse polarity protection built in. However, the unit will not turn on.



Connect the **Ethernet RJ-45** port to the camera network or an Ethernet switch. The camera network typically includes 1 to 7 FLIR cameras connected to a single Ethernet Switch. You may also connect a PC or laptop to the Ethernet switch for configuration of the cameras and the MIO module.

Connect the 4-20mA analog outputs to any device with 4-20mA signal inputs, such as industrial PLCs, 4-20mA data loggers, 4-20mA signal monitoring/alarm devices, etc. Keep in mind that from the perspective of the MoviTHERM MIO I/O module, these are outputs. The 4 to 20mA outputs are active, or loop powered. This indicates that they will provide a loop voltage to the connected device. No additional power source is necessary or should be added. Make sure to observe the connected polarity of the 4 to 20mA device.

Connect the digital outputs to discrete signal inputs on alarms, warning lamps, auto-dialers, PLCs, etc.

For more details on how to connect devices, please go to **Section 7.1 – I/O Connections**.

Figure 2 illustrates a typical installation scenario.

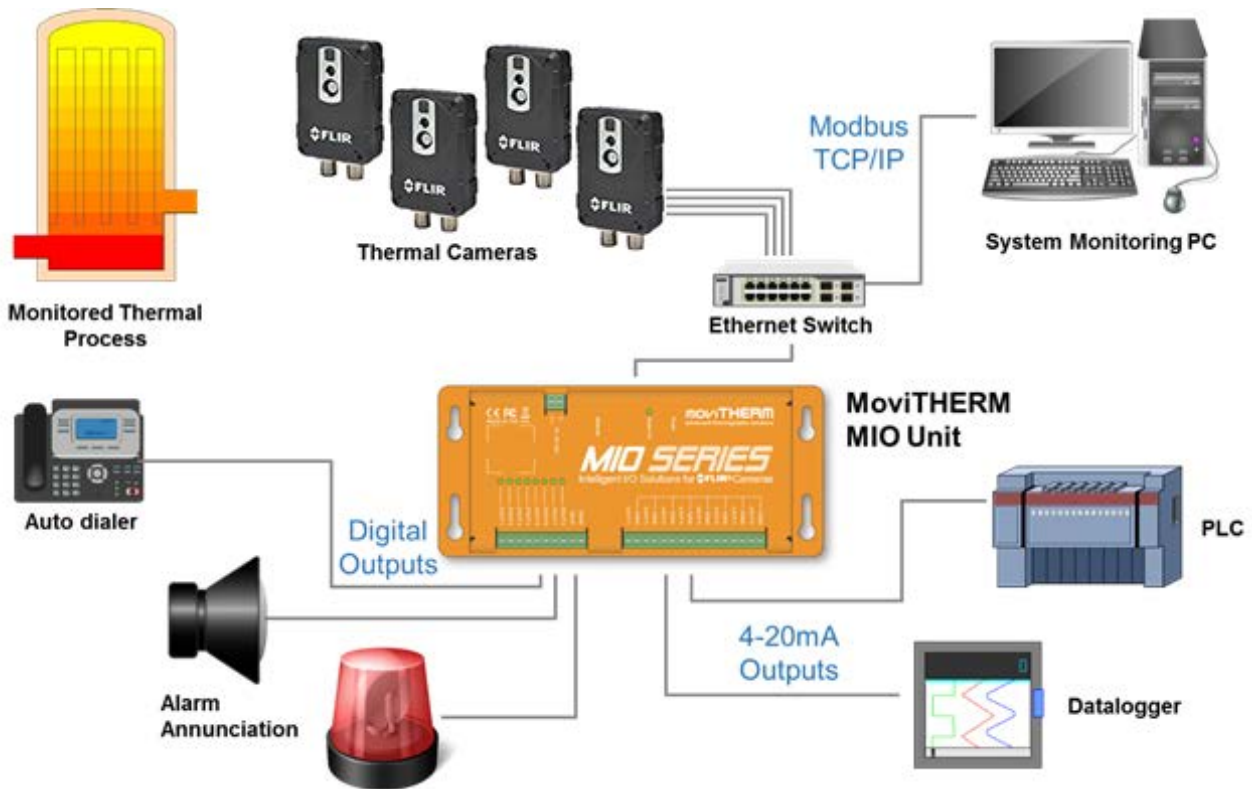


Figure 2: A typical MoviTHERM MIO Monitoring Installation



Do not operate the device in a manner that is not specified in this document. Misuse of the device may result in a malfunction or safety hazard. It will also void the warranty.



Never operate this device in an explosive environment where flammable gases, dust, fumes or other volatile materials may be present. If you must operate this device in a hazardous or explosive environment, it must be installed in a suitably rated enclosure with the necessary provisions.



To ensure proper performance consistent with the specifications of this device, please carefully read this user manual and observe all cautions, operating conditions and limits.

5 Specifications

Model	MIO-AX8-7
Compatible Cameras	FLIR® AX8
Maximum Cameras Supported	7
Ethernet Connection	100Base-T
Communication Protocol	Modbus TCP/IP
4-20mA Transmitter Channels	8 CH, Group Isolated, Self-Powered
Digital Output Channels	8
Digital Output Current	0.5A per Channel, 1.5A all Channels
Digital Output Voltage	10-30VDC
Power Supply Voltage	24 VDC
Maximum Power Consumption	7W
Dimensions	8.8 x 3.9 x 1.2 in (223 x 99 x 31 mm)
Weight	0.7 lbs. (0.32 kg)
Enclosure Material	Anodized Aluminum
Operating Temperature	0°C to 50°C (32°F to 122°F)
Relative Humidity	0% to 95% RH, non-condensing

6 System Installation and Set-up

The MoviTHERM MIO Series of Intelligent I/O modules have an anodized aluminum enclosure. This enclosure is intended to protect the internal electronics only from larger objects and general handling. The MIO I/O module is intended to be mounted inside an existing electrical cabinet or other protective enclosure.

The MIO I/O Module is rated NEMA1 / IP20

Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt. Protected against solid foreign objects of 12mm in diameter and greater. No protection against water.



The MIO I/O module **is not** protected against ingress of dust, conductive particles, moisture or liquid splashing.



For installations in dirty, dusty, hot, wet or otherwise harsh or hazardous areas, provisions have to be made to adequately protect the MIO I/O module.



Please do not stick any tools or metal objects inside the MIO module. This may create an electrical shortcut and permanently damage the unit. This will also void the warranty.

For indoor industrial or outdoor environments, we recommend placing the MIO I/O module at least inside an electrical enclosure rated NEMA4 or NEMA4x. No cooling is required, as long as the inside temperature of the protective enclosure will not exceed the max allowable operating temperature of the MIO module.

To ensure proper operation and continuing reliability, all set-up and configuration tasks should be completed by qualified engineers or service technicians. The information in this manual provides some direction, but should not be considered a substitute for extensive experience.



If you are unsure how to proceed, contact your distributor or MoviTHERM technical support for further directions under support@movitherm.com. Please include the serial number of your MoviTHERM MIO.

Or visit the MoviTHERM Website www.movitherm.com and use the contact methods provided there.

6.1 Configuration Procedure

After the electrical connections have been made and verified, it is time to configure the cameras and the MoviTHERM MIO device. The FLIR AX8 cameras are configured using **FLIR IP Config** and the camera's built in web server. The MIO device is configured using the browser-based **MoviTHERM MIO Configuration Utility**, as discussed later in the manual.

Configuring the system is a four step process:

- 1) Set the cameras to a fixed IP addresses using the **FLIR IP Config** application.
- 2) Configure the Regions of Interest or "ROIs" in all cameras using the camera's built it web server.
- 3) Define the thresholds and action criteria for each ROI using the browser-based **MoviTHERM MIO Configuration Utility**.
- 4) Configure the MIO board response using the **MoviTHERM MIO Configuration Utility**.



Steps 3 & 4 cannot be completed until Steps 1 and 2 are complete. Step 1 requires the **FLIR IP Config** software utility bundled with the camera. Steps 3 & 4 use a standard web browser interface to access the **MoviTHERM MIO Configuration Utility**. Consult the appropriate FLIR camera user manual for details on how to setup the camera.

6.1.1 IP Configuration

It is important to understand that although the MIO device and the cameras share a single Ethernet connection, the cameras and the MIO device must all have separate and unique TCP/IP addresses. The cameras must be configured to use **static** IP addresses. The **FLIR IP Config** utility software is used to set the camera IP addresses. The MoviTHERM **MIO Configuration Utility** will be used to set up the IP address on the MIO device (as discussed in the next chapter).

IP SUBNET CONFIGURATION - IMPORTANT NOTE:

The cameras and the MIO device must all be assigned unique IP addresses. However, in order to share the same Ethernet cable connection, all of the IP addresses must reside within the same subnet. This is most easily accomplished by ensuring that the 1st, 2nd, and 3rd IP address fields are common for all devices, while the 4th field is unique for each device.

For example, the default IP address for the MIO device is defined as follows:

MIO IP address:	192.168.1.2
Subnet mask:	255.255.255.0

If this default is left unchanged, suitable camera IP addresses might be:

Camera IP address 1:	192.168.1.3
Camera IP address 2:	192.168.1.4
Camera IP address 3:	192.168.1.89 (etc.)

If the MIO device IP is modified (as outlined later in this document), the camera IP address may need to be updated accordingly.

After the camera IP addresses have been assigned, you will be ready to define the Regions of Interest that will be used by the MIO device. Refer to the **FLIR AX8** User Manual for detailed information about defining the camera regions of interest for FLIR-AX8 camera models. You must complete the Region of Interest configuration before moving on to configure the MoviTHERM MIO device.

6.2 Preparing MIO for Configuration

Keep in mind, you always need to have the camera's regions of interest configured before you configure the MIO. The MIO is trying to find configured regions of interest in each camera in order to perform the selected actions. You can configure one or many ROIs in each camera. You are only limited by the number of available outputs on the MIO I/O. If more outputs are needed, or you need to monitor more than seven cameras in your application, simply add another MIO I/O module to your network.



Supported Web Browsers - The following web browsers are supported by the MIO. If you are using an older version than the supported version and are experiencing issues, update to the latest version or use another supported browser.

Microsoft Edge – 38.0

Google Chrome – 53.0

Firefox – 48.0

6.3 Assigning Actions to Camera Regions: The MIO Controller Utility

Once Regions have been defined in the cameras, you are ready to assign actions based on temperatures detected. Start by launching a web browser (Google Chrome, Microsoft Edge, Firefox) from your Windows Desktop or Start Menu. When the browser window opens, type the MIO Controller Board IP address into the Address (URL) field at the top of the browser window, as shown in Figure 4.

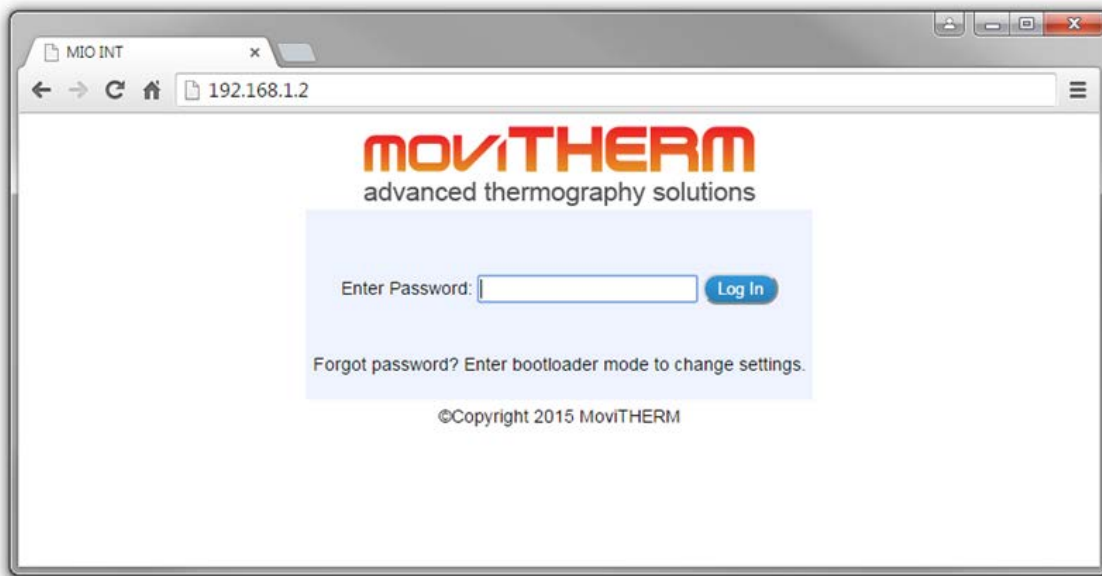


Figure 4: MIO Access Log-in Dialog

If the correct IP address is entered, the Password Login dialog will appear in the browser window as shown here.

Enter the Administrator log-in password in the field provided, and click the **Log In** button to continue. When the correct password has been entered, the Device Settings Tab will open in the browser window, as shown in Figure 5.

NOTES:

For simplicity, the default log-in password is set to “**password**”. After system installation, you may want to change the password to reduce the potential for unauthorized system access. (Additional information about changing the password can be found in the section that discusses Recovery Mode.)

The MoviTHERM MIO Device IP Address has been pre-configured to **192.168.1.2**. This is the **factory default IP setting**. However, the board’s IP address is configurable, so if the IP address has been changed, you may need to provide a different IP address than the one shown here. If you know the correct IP address, enter it into the Address (URL) field. If you are uncertain, try the default IP address: 192.168.1.2 first. If you are unable to connect using this address, you may need to perform a Network Reset. (For more information, refer to the IP Address Reset section later in this chapter for more details.)

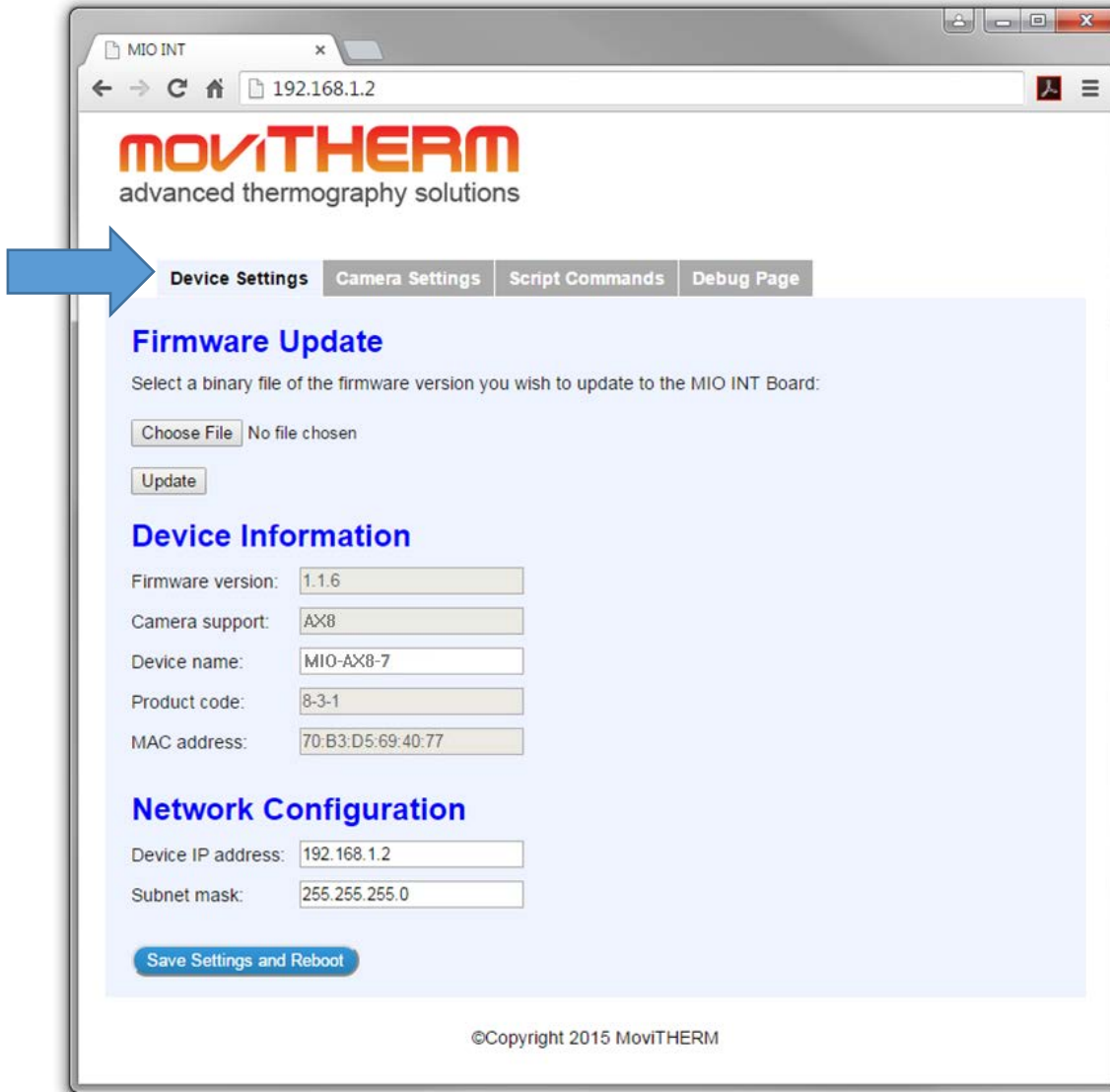


Figure 5: The MIO Controller Utility opens to the Device Settings tab after the correct password has been entered.

6.3.1.1 The Device Settings Tab

The Device Settings tab (shown in Figure 5) is the default start-up page. When you access the MIO Board Configuration from your browser, this is the tab that will appear after entering the correct log-in password. The text fields with a white background are editable fields. The text fields with a grey background display current system parameters, but are not user-editable.

The **Device Settings** tab is used to:

- 1) set the Network Configuration (IP Address and Subnet),
- 2) enter an optional user-defined Device Name
- 3) execute a firmware update

6.3.1.2 Network Configuration

To change the Network Configuration, simply type the new Device IP address and Subnet mask in the fields provided. Similarly, to change the Device name, simply type a user-specified name into the Device name field provided. Click “Save Settings and Reboot” to save the changes.

Note: If you change the IP address and then click “Save Settings and Reboot”, the board will run through a short reset cycle before opening a link to the new IP address. When the browser page updates, the Device IP address and Subnet mask fields will reflect the changes. (See Figure 6.)



Figure 6: IP Address changed - view after Save and Reboot

6.3.1.3 IP Address Reset

If you changed the IP Address, but have forgotten the new setting, an IP Address Reset operation will temporarily reset the IP address to the factory default. In order to reset the IP address, you will need to access the DIP switches on the MIO device. (The DIP switches can be accessed through the cut-out port located to the right of the MIO Ethernet port.)



When you have located the DIP switches, follow these steps to reset the IP address to the **factory default** setting: **192.168.1.2 (Subnet Mask: 255.255.255.0)**

While the unit is powered on:

Step 1: Turn on the IP Reset DIP switch (see Figure 7)



Figure 7: Set the IP reset DIP Switch to ON

Step 2: Reset the device by either:

a) Power module off, wait 10 seconds, power on

Or

b) Press the reset button, using a paper clip. The reset button is located behind a small hole on the backside of the enclosure. See left blue arrow above.

Step 3: After the device reboots, log in to the device using the default IP address: **192.168.1.2**

Step 4: Turn off the IP Reset DIP switch (see Figure 8)

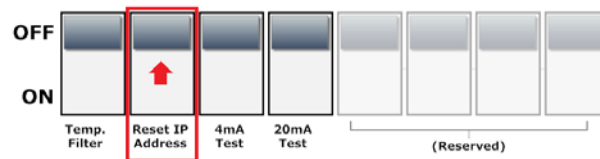


Figure 8: Clear the IP reset DIP Switch (OFF)



For setting the IP Address back to a user-defined value, return to the previous Network Configuration section of this document. Keep in mind that every time you are changing the IP address of the device, the connection in your browser (or to all other devices) may be lost. Make sure to change the IP address in the browser to the newly configured IP address to re-establish the connection.

6.3.1.4 Firmware Update

The Firmware Update option at the top of the Device Settings tab is an advanced feature that allows you to quickly and easily upgrade the Firmware (embedded software) running on the board. The Firmware Update process involves the following steps:

- 1) Download the Firmware file to your PC
- 2) Click the “Choose File” button under “Firmware Update” on the “Device Settings” tab (Fig. 9)
- 3) Navigate to the Firmware file (from Step 1) using the file browser, and select it. The filename will appear next to the “Choose File” button.
- 4) Click the “Update” button under “Firmware Update” on the “Device Settings” tab (Fig. 9)
- 5) The firmware update will be loaded into the MIO Device. The device will reboot and reconnect.

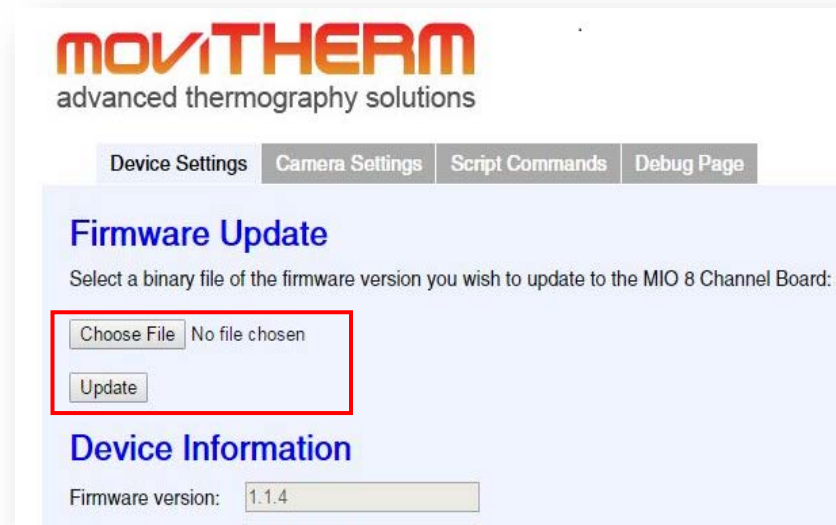


Figure 9: Buttons for initiating the Firmware Update

When the Firmware update cycle is complete, you will be returned the Device Settings Tab.

6.3.2 The Camera Settings Tab

The Camera Settings Tab is used to link the camera IP addresses to the MIO Controller board. This step permits the cameras to communicate with the board, enabling its functionality. When you click on the Camera Settings tab, the tab depicted in Figure 10 loads into the browser window.

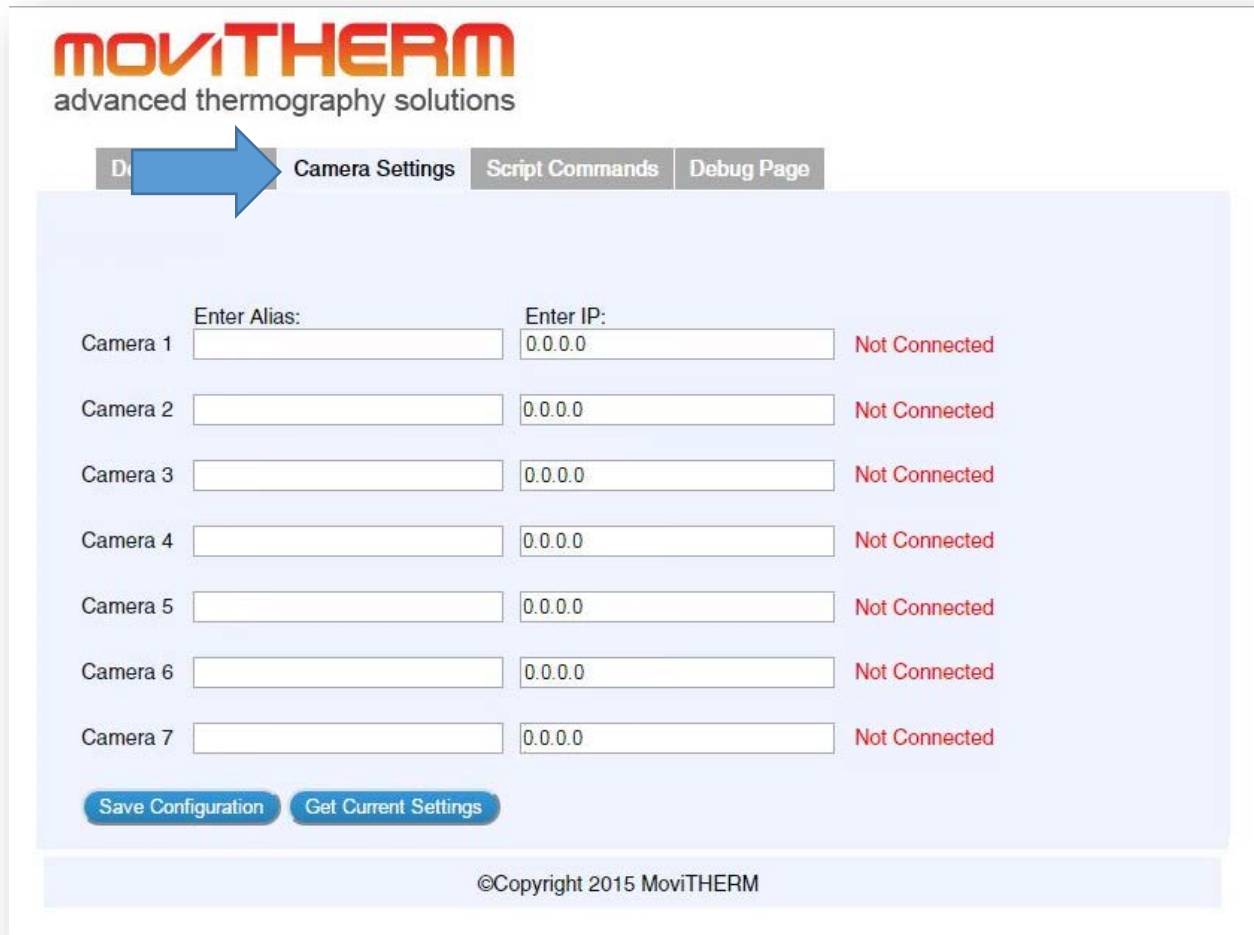


Figure 10: The Camera Settings Tab - awaiting configuration



Enter a name or *alias* for each camera in the field provided, along with the corresponding IP address for the camera, as illustrated in Figure 11, and press the “Save Configuration” button. As the MIO Board connects to the cameras, the green “Connected” text will replace the red “Not Connected” text to the right of the camera specification, as shown in Figure 11.

The “Alias” allows the user to provide a more meaningful name or reference to any particular camera, rather than having to memorize a cryptic IP address number. The alias name has no other use than that and will not affect any functionality.

The screenshot shows the MoviTHERM web interface for camera settings. It features a navigation bar with tabs for 'Device Settings', 'Camera Settings', 'Script Commands', and 'Debug Page'. Below the navigation, a 'Load complete!' message is displayed. The main content area contains a table with the following data:

Camera	Enter Alias:	Enter IP:	Status
Camera 1	Mercury	192.168.1.3	Connected
Camera 2	Venus	192.168.1.4	Connected
Camera 3	Earth	192.168.1.5	Connected
Camera 4	Mars	192.168.1.6	Connected
Camera 5	Jupiter	192.168.1.7	Connected
Camera 6	Saturn	192.168.1.8	Connected
Camera 7	Uranus	0.0.0.0	Not Connected

At the bottom of the form, there are two buttons: 'Save Configuration' and 'Get Current Settings'. A copyright notice '©Copyright 2015 MoviTHERM' is located at the very bottom of the interface.

Figure 11: Sample Camera Configuration

6.3.2.1 Saving and Loading Configurations

The MIO device maintains one complete configuration in non-volatile memory. You can use the “Save Configuration” button to store the current configuration as displayed on the Camera Settings tab into the device memory. On power reset, the most recently saved configuration is used by the device. You can also use the “Get Current Settings” button to load the most recently saved configuration from the device memory into the Camera Settings tab for inspection or further editing.

6.3.2.2 The Script Commands Tab

After the camera settings have been set up, the next task is to set up the script commands that create the intended system responses. The Script Commands tab is used to configure the commands configuration. (See Figure 12.)

The screenshot shows the 'Script Commands' tab in the MoviTHERM web interface. It features two main sections: 'Analog Channels' and 'Digital Channels'. Each section contains a table with 8 channels (Channel 0 to Channel 7). The 'Analog Channels' section includes columns for Camera Number, Command, Region of Interest, Analog Output Mode, Low Temperature, and High Temperature. The 'Digital Channels' section includes columns for Camera Number, Command, Region of Interest, and Threshold Temperature. All dropdown menus are currently set to 'No Camera Selected', 'No Command Selected', and 'No ROI Selected'. The temperature fields are set to 'Enter Low Threshold (C)'. At the bottom of the form, there are two buttons: 'Save Configuration' and 'Get Current Settings'.

Figure 12: The Script Commands tab - prior to configuration.

The configuration procedure is straight-forward:

- 1) Select the Camera from the pull-down menu in the left-most column
- 2) Select a Command from the second pull-down menu (as shown in Figure 13)
- 3) Assign the selected Command to a Region of Interest (ROI) by selecting the Region Interest using the pull-down menu. (The Regions of Interest must be predefined in the camera the **web-browser** utility for **FLIR AX8** cameras as discussed previously.)
- 4) In the case of an Analog Output command, assign the Analog Output Mode, “Linear” or “Threshold” (information about these modes is provided below).

- 5) If “Threshold” mode is used, set the Temperature Threshold(s) needed to initiate the specified action in the Low Temperature box. If “Linear” mode is used, enter the value which should correspond to 4 mA in the Low Temperature box and the value which should correspond to 20 mA in the High Temperature box.

Repeat these steps for each Analog and/or Digital channel as needed, then save the configuration by clicking the “Save Configuration” button.

Figure 13: Command pull-down menu options



You can assign multiple outputs (digital and analog) to the same camera, if needed. For example, if you have four regions of interest configured within one and the same camera, you can also assign four separate digital outputs to these regions. Each with their own alarm threshold. In addition, you can also assign analog 4 to 20mA to the same regions as well for external monitoring or control. It is entirely up to you, how you utilize the resources in the MIO I/O module. If you run out of outputs, you can add another MIO I/O module to the network and expand your system that way.

6.3.2.3 Command Options

The Command Options can be summarized in the following categories:

- 1) System Status
- 2) Delta Temperature
- 3) Internal Camera Temperature
- 4) Spot Temperature
- 5) Box Temperature (Max, Min, or Average)
- 6) Alarm trigger

System Status

System Status is a special configuration option that can be used to monitor camera connectivity. When the System Status Command is assigned to an output channel, the selected channel can be used to monitor Ethernet connectivity. If all of the cameras entered in the “Camera Settings” tab have active

Ethernet connections to the MIO (0.0.0.0 IP address are not considered), the output will be logical "HIGH" (20mA output). If one or more camera connectivity issues are detected, the selected output channel will reflect a logical "LOW" (4.0 mA) state.

Delta Temperature

The Delta Temperature command enables you to initiate an action based on the difference between two parameters. For example, an action could be based on the difference between the minimum and maximum temperature readings within a single region. Alternatively, two regions could be compared, or the camera's internal temperature register could even be compared with a region in the image. The difference between any two eligible camera parameters can be used as the basis for the delta comparison. (Refer to the FLIR Camera user manual for how to setup delta temperature functions in the camera)

Internal Camera Temperature

The Internal Camera Temperature option selects the camera's internal temperature as the data source. This option can be used to monitor the temperature environment of the camera, and alert the user to unusual operating conditions.

Spot Temperature

Select the Spot Temperature option to use a predefined spot temperature as the data source. (Refer to the FLIR Camera manual for more details about configuring a Spot Temperature measurement.)

Box Temperature (Max, Min, or Average)

Select the Box Temperature option to use a predefined Box temperature (max, min or average) as the data source. . (Refer to the FLIR Camera manual for more details about configuring a Box Temperature measurement.)

Alarm Trigger

Each camera can be configured to generate **Alarm Trigger** events in response to a variety of inputs. Measurement results from within the image, the instantaneous state of a digital input, or even a camera's internal temperature could potentially be configured to generate an alarm. Selecting the Alarm Trigger option assigns the state of the alarm flag as the data source for MIO device operations. (Refer to the FLIR Camera manual for more details about configuring alarms in the camera.)

6.3.2.4 Region of Interest Selection

The **Region of Interest** field is located to the right of the **Command** field. The available **Region of Interest** options will depend on the **Command** option selected. For example, if you select the System Status, Internal Camera Temperature, Delta Temperature, or Alarm option in the Command pull-down, the Region of Interest specification is not relevant. The Region of Interest field will be disabled and unavailable for editing. However, if you select a Spot or Box source in the Command field, it becomes necessary to specify which of the pre-defined Spots or Boxes applies. In this case, the Region of Interest field will be enabled and populated with all the available regions (Spots and Boxes). After specifying the appropriate region, you can move on to specify the Output Mode (in the case of Analog Output channels), and the temperature threshold(s).

6.3.2.5 Analog Output Mode

The **Analog Output Mode** selection determines the behavior of the specific analog output channel. Two options are available: Linear Output or Threshold Output. When Linear Output is selected, the specified output channel will produce a scaled 4-20mA signal based on the selected Command and Region of Interest. The scaling is based on the values entered in the Low and High Temperature fields (4mA for values \leq Low Temperature, 20mA for values \geq High Temperature). When Threshold Output is selected, the output channel will produce a discrete low (4mA) or high (20mA) signal, based on the temperature threshold value(s) set in the Low Temperature field.



You can scale the 4 to 20mA output to either the selected temperature range of the camera, or a custom scale. For example, if the selected temperature range of the camera is 0°C to 350°C, then enter '0' in the field "Low Temperature" and '350' in the field named "High Temperature. In this example, a 4mA output signal equals to 0°C and 20mA equals to 350°C. Setting the low temperature or high temperature outside the selected camera temperature range is not recommended. However, you may select a different range **within** the calibrated temperature range of the camera. This is useful, if you know that your process temperature may never go below or above a certain value. For example, your process temperature may be between 70°C and 150°C, while the temperature range of the camera is 0°C to 350°C. Setting the scaling of the 4 to 20mA output of the MIO module to your min. and max. range of your expected process temperature allows you to stretch the range across the entire 4 to 20mA range. However, this will not increase the accuracy of your system.



It is also possible to use the analog 4 to 20mA outputs as threshold or alarm outputs. In other words, if you select the "Threshold" option, rather than the "Linear Output" option. This function allows any analog output to behave like a digital output in a sense. In this case a 4mA current indicates a logic low signal and a 20mA current signals a logic high or alarm. This is useful, if you run out of digital outputs and want to extend the I/O of the module. Some 4 to 20mA controllers also "understand" this sort of signaling as alarm condition.

An example of a completed configuration is shown in Figure 14.

The screenshot shows the 'Script Commands' tab of the MoviTHERM configuration interface. It is divided into two sections: 'Analog Channels' and 'Digital Channels'. Each channel is configured with a camera number, a command, a region of interest, an output mode, and temperature thresholds.

Channel	Camera Number	Command	Region of Interest	Analog Output Mode	Low Temperature	High Temperature
Channel 0	Camera 1	Delta Temperature 1	No ROI Selected	Linear Output	11	111
Channel 1	Camera 2	Internal Camera Temperat	No ROI Selected	Threshold Output	22	222
Channel 2	Camera 3	Spot Temperature	ROI 1	Linear Output	33	333
Channel 3	Camera 4	Box Min Temperature	ROI 2	Threshold Output	44	444
Channel 4	Camera 5	Box Max Temperature	ROI 3	Linear Output	55	555
Channel 5	Camera 6	Box Average Temperature	ROI 4	Threshold Output	66	666
Channel 6	Camera 1	Alarm 1	No ROI Selected	Threshold Output	Enter Low Threshold (C)	Enter High Threshold (C)
Channel 7		System Status	No ROI Selected	Threshold Output	Enter Low Threshold (C)	Enter High Threshold (C)

Channel	Camera Number	Command	Region of Interest	Threshold Temperature
Channel 0	Camera 6	Internal Camera Temperat	No ROI Selected	77
Channel 1	Camera 5	Spot Temperature	ROI 1	88
Channel 2	Camera 4	Box Min Temperature	ROI 2	99
Channel 3	Camera 3	Box Max Temperature	ROI 3	111
Channel 4	Camera 2	Box Average Temperature	ROI 4	222
Channel 5	Camera 1	Alarm 7	No ROI Selected	Enter Low Threshold (C)
Channel 6	Camera 6	Delta Temperature 1	No ROI Selected	333
Channel 7		System Status	No ROI Selected	Enter Low Threshold (C)

Buttons at the bottom: Save Configuration, Get Current Settings

Figure 14: Sample Configuration

To summarize, each output channel is configured via the Script Commands tab (as shown in Figure 14). The usual procedure is to start by selecting a camera using the pull-down camera selector menu. After selecting a camera, a Command should be specified. If the selected Command specifies a Spot or Box temperature, you will also need to select a Region of Interest. For Analog Outputs, an Analog Output Mode must be selected – either a Linear 4-20 mA analog signal that changes proportionally based on the selected Region of Interest, or a discrete 4 or 20mA Threshold Output, based on a comparison of the Region of Interest with the temperature threshold settings. (Note that the Digital Channels behave similarly to the Analog Threshold Output mode.)

6.3.2.6 Saving and Loading Configurations

Just like the Camera Configuration (discussed previously), the MIO device maintains one complete set of Script Commands in non-volatile memory. You can use the “Save Configuration” button to store the current configuration as displayed on the Script Commands tab into the device memory. On power reset, the most recently saved configuration is used by the device. You can also use the “Get Current Settings” button to load the most recently saved configuration from the device memory into the Script Commands tab for inspection or further editing.

6.3.3 The Debug Tab

After the configuration has been defined, the Debug Tab (in Figure 15) provides a convenient, interactive window into the real-time operation of the MIO Board. Using the Debug tab, you can observe the current status of all output channels and DIP switches at a glance. You can use this tab to validate output channel operations.

Device Settings	Camera Settings	Script Commands	Debug Page
Analog Channels			
Channel 0:	11.999 mA		
Channel 1:	11.999 mA		
Channel 2:	11.999 mA		
Channel 3:	11.999 mA		
Channel 4:	11.999 mA		
Channel 5:	11.999 mA		
Channel 6:	11.999 mA		
Channel 7:	11.999 mA		
Digital Channels			
Channel 0:	OFF		
Channel 1:	OFF		
Channel 2:	OFF		
Channel 3:	OFF		
Channel 4:	OFF		
Channel 5:	OFF		
Channel 6:	OFF		
Channel 7:	OFF		
DIP Switches			
Switch 1 (Filter):	ON		
Switch 2 (Reset IP):	OFF		
Switch 3 (4 mA Test):	ON		
Switch 4 (20 mA Test):	ON		
Switch 5 (Reserved_1):	OFF		
Switch 6 (Reserved_2):	OFF		
Switch 7 (Reserved_3):	OFF		
Switch 8 (Reserved_4):	OFF		

Figure 15: The Debug Tab shows the current output state of each MIO Board output channels and the DIP switch states

6.3.3.1 MIO Board DIP Switches

The DIP Switches control advanced board functions. The position of each switch is shown below in Figure 16.

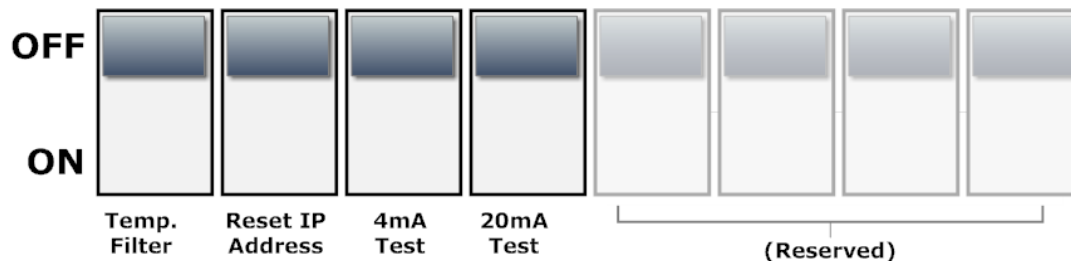


Figure 16: MIO Board DIP Switches

6.3.3.2 DIP Switch Functions

Switch 1 – Filter: Enabling the Filter switch activates a running average filter (10 samples) on the temperature INPUTS. This function may provide better performance for monitoring applications involving a constantly variable temperature source such as a flickering flame. The filter is globally applied to all seven cameras and all configured regions of interest.

Switch 2 – IP Reset: The IP Reset switch is used to reset the IP address to the factory default setting. (For more information, refer to IP Address Reset under the Device Settings Tab discussions earlier in this document.)

Switch 3 – 4mA Test: When enabled, all analog channels will output a “logical low” 4mA signal.

Switch 4 – 20mA Test: When enabled, all analog channels will output a “logical high” 20mA signal.

NOTE: When **both** Switch 3 (4mA Test) **and** Switch 4 (20mA Test) are enabled, a 12mA half-scale signal will be output on all analog channels

Switches 5-8: [Reserved for Future Expansion]



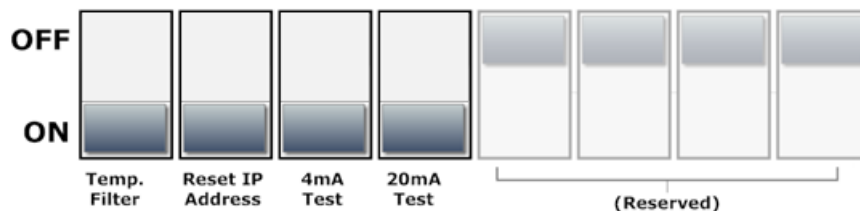
All MIO Series I/O modules have a built-in loop calibrator and simulator. The 4 to 20mA signal has 16-bit resolution and is very accurate. By using dip switch 3,4 and 3&4 together you can simulate 4mA, 12mA or 20mA in your setup. The current that the board outputs is being indicated on the debug page. Therefore, you do not need a separate instrument such as a loop calibrator or multi-meter to verify your system. This feature lets you troubleshoot issue and quickly very how your scaling is setup on the MIO I/O module as well as on the receiving device.

6.4 Recovery Mode

The Recovery Mode (depicted in Figure 17) is an advanced mode that can be used to reset the MIO device to its original factory settings. Similar in appearance to the Device Settings Tab discussed previously, the Recovery page includes two key differences:

- 1) a button to clear camera and script settings
- 2) a field to enter a new system password.

To enter into **Recovery Mode**, you must first set all the DIP switches to the ON position and reset the board. The reset function is activated by pressing the Reset button (on the reverse side of the board), or by power-cycling the unit.



Only use the **recover mode** as a last resort. You may lose all system settings. The recovery mode is typically only necessary, if a firmware update has failed or you can't access the unit via the web-browser anymore.



Before attempting a system recovery, please make sure to try an IP Address reset first to see, if you can access the MIO I/O module. Sometimes Windows Firewall settings, Virus Scanners, web browser privacy or security settings may prevent you from accessing the unit instead.

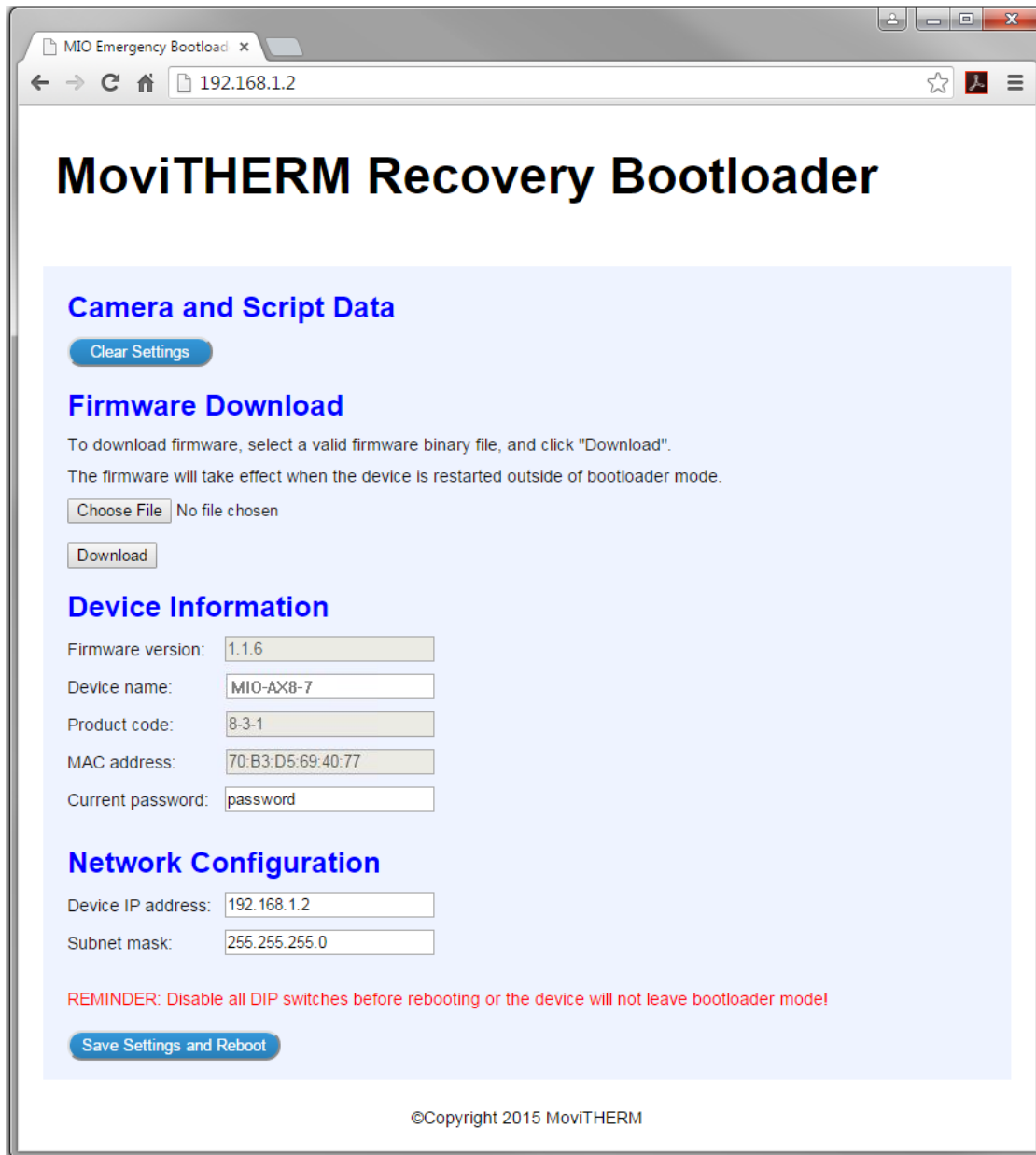


Figure 17: Set all DIP switches ON and power-cycle to open the Recovery panel

6.4.1 Password Reset

To reset the access password, make sure the unit is already in “Recovery Bootloader Mode”

1. Type a new password into the current password field
2. Switch all DIP switches to the OFF position
3. Click the “Save Settings and Reboot” button
4. When the system restarts, use the new password to log into the Device Settings tab
5. Switch the DIP switches switched to OFF under 2.) back to the desired position.

7 Operations

The MIO-AX8-7 provide eight (8) 4 to 20mA analog outputs and eight (8) digital outputs. In order to benefit from this connectivity, the MIO signals must be connected to other devices such as PLCs, data-loggers, warning lamps, alarm equipment, etc. This chapter is devoted to connecting the MIO unit to external devices.

7.1 I/O Connections

All I/O connections are made via the screw terminal I/O Connectors as denoted in Figure 18.

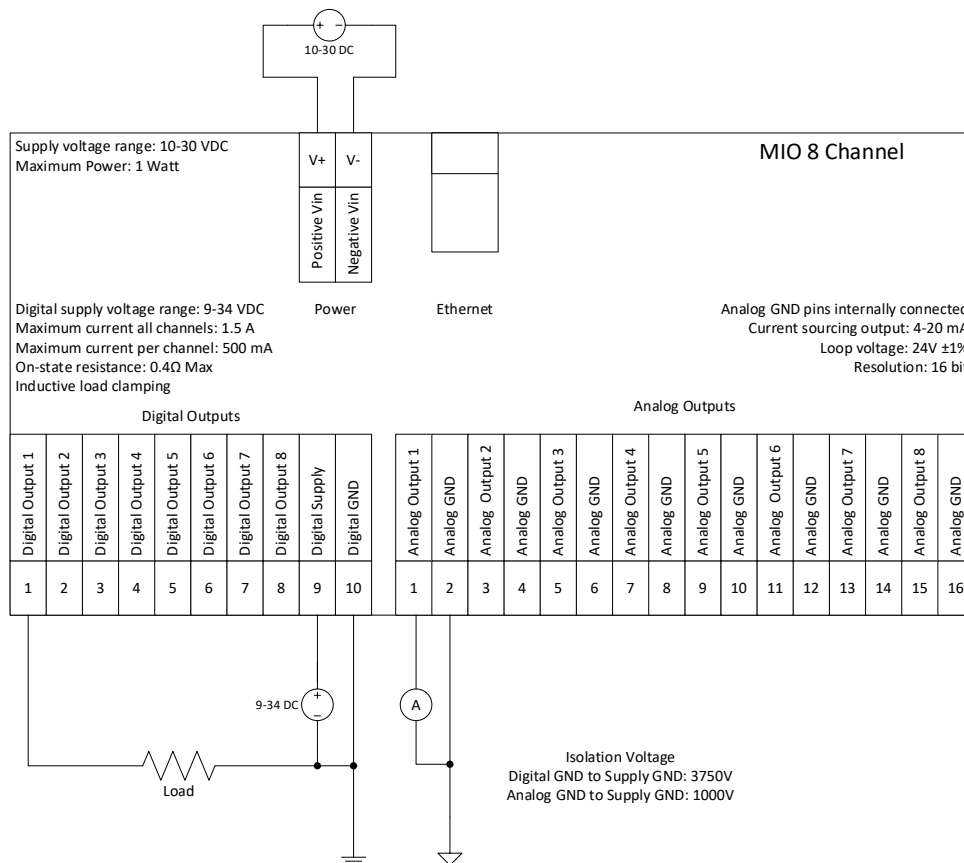


Figure 18: I/O Mapping and Connectivity

The I/O ports are organized into two groups: **Digital Outputs** and **Analog Outputs**. When looking at the side of the MIO enclosure with the I/O port cutouts, the Digital Outputs appear to the left of the Analog outputs.

7.1.1 Digital Output Pin Definitions

From left to right, the DOUT pins are defined as:

- Pin 1: DOUT 1
- Pin 2: DOUT 2
- Pin 3: DOUT 3
- Pin 4: DOUT 4
- Pin 5: DOUT 5
- Pin 6: DOUT 6
- Pin 7: DOUT 7
- Pin 8: DOUT 8
- Pin 9: DSUP (DOUT Supply)
- Pin 10: DGND (DOUT Ground)

Refer to Figure 19 for DOUT channel circuit and connection diagram.

7.1.2 Analog Output Pin Definitions

From left to right, the AOUT pins are defined as:

- Pin 1: AOUT 1
- Pin 2: AGND
- Pin 3: AOUT 2
- Pin 4: AGND
- Pin 5: AOUT 3
- Pin 6: AGND
- Pin 7: AOUT 4
- Pin 8: AGND
- Pin 9: AOUT 5
- Pin 10: AGND
- Pin 11: AOUT 6
- Pin 12: AGND
- Pin 13: AOUT 7
- Pin 14: AGND
- Pin 15: AOUT 8
- Pin 16: AGND

Refer to Figure 19 for AOUT channel circuit and connection diagram.

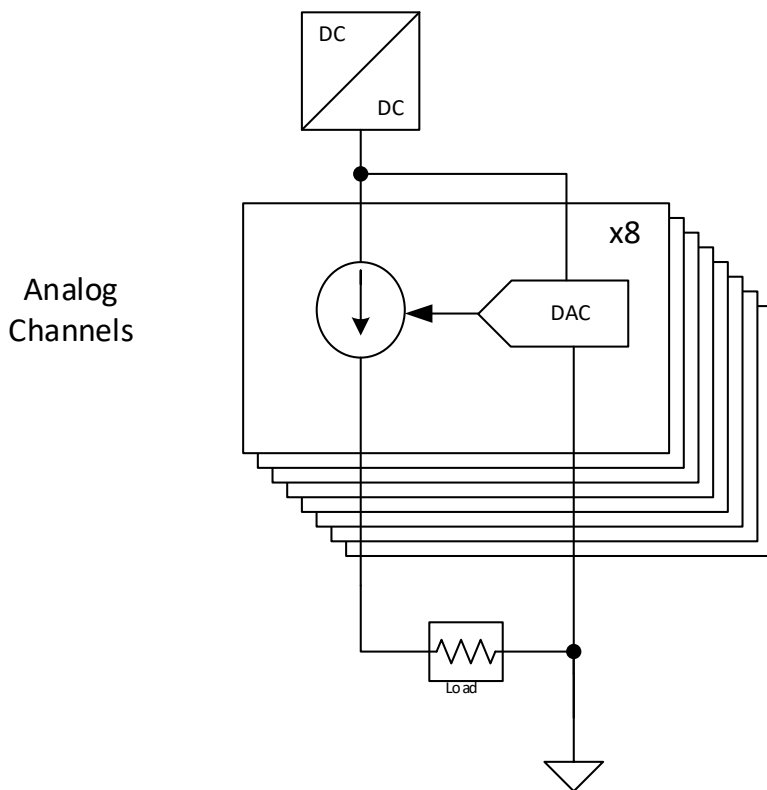
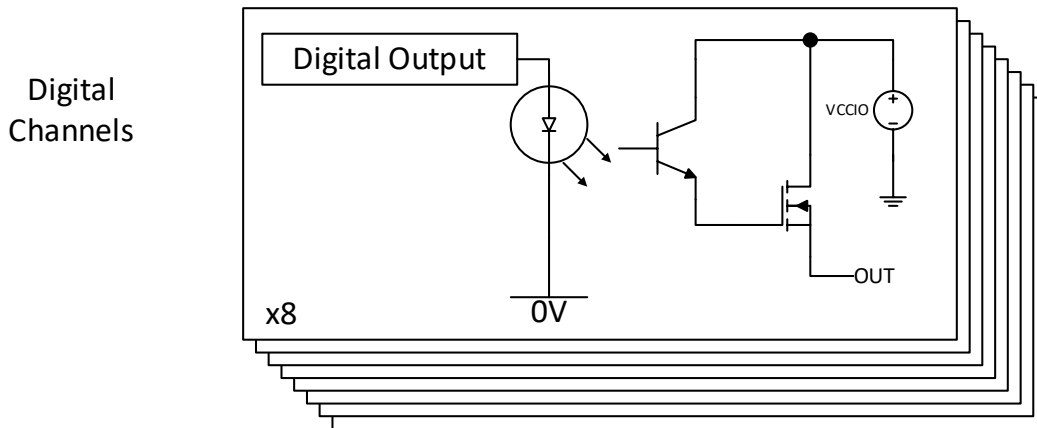


Figure 19: DOUT and AOUT Channel Circuit Diagrams

The DOUT signals (DOUT 1 to DOUT 8) when active (**turned on**) will **source** the voltage connected to the DSUP terminal with reference to DGND. Therefore, an external power supply needs to be connected to the terminal DSUP ('+') and DGND ('-'). The supplied voltage can be between 9 and 34VDC. Most common voltages used are either +12VDC or +24VDC.



Each output can source up to **0.5A** individually. However, the total sum of all current sourced through any of the digital outputs cannot and shall not exceed **1.5A**. If higher currents are required, please add a relay or other suitable power switch to protect the output.



If all outputs are turned on, then the following needs to be observed:

$1.5A/8 = 0.188A$ max. per digital output. In other words, if you would like to connect a relay to each output, please make sure that each relay coil draws $\leq 0.188A$.

Example: You are using a 12VDC/2A external power supply for the digital outputs. The power supply is connected to DSUP ('+') and DGND ('-'). You have eight electro-mechanical relays with 12VDC coils. The coil resistance is 120Ω.

To calculate the required current per each relay, we can use the Ohm's Law.

$$\begin{aligned} \text{Coil Current} &= \text{Coil Voltage/Coil Resistance} \\ &= 12V/120\Omega \\ &= 0.1A \text{ or } 100mA \end{aligned}$$

The above relay would be suitable, since it only draws 0.1A.

$0.1A \times 8 \text{ Channels} = 0.8A$ total.

The digital outputs are protected against thermal overload, over current and transients from inductive loads. It is good engineering practice to select relays with a coil current less than 0.15A or 150mA.

The positive (+) terminal of the external (load) device is connected to the DOUT channel on the MIO device, as illustrated in Figure 18. The load's negative (-) terminal must be connected to the Digital Ground (Pin 10), which will share a connection to the negative (-) terminal of the 9-34VDC digital power supply.

NOTE: If using the digital output to signal a digital input device, a pull-down resistor must be used. A common value is 10K. This may also be the case for driving SSR (Solid State Relays).

The AOUT signal pairs are "self-powered" 4-20mA output signals. Loop power is provided by an on-board isolated 24VDC power supply. The recommended wiring configuration is depicted in Figures 18 and 19. The positive (+) terminal of the power source should be connected to the lower-numbered pin of the pair (i.e. Pin 1 for AOUT 1 or Pin 3 for AOUT 2). The negative (-) load terminal should be connected to the AGRND, which is connected to the negative (-) terminal of the power source.

AOUT(n) channels are group isolated outputs, which is to say that they are isolated from the main 24V power and all other digital output signals, but not from each other. All AGNDs are connected to each other internally.

8 Troubleshooting Common Issues

Camera Image Issue	Possible Causes	Recommended Action
Unable to connect to the Thermal Camera over Ethernet	<ol style="list-style-type: none"> 1) No Camera Power 2) No Ethernet Connection 3) Incorrect IP Settings 4) Camera Hardware Failure 	<ol style="list-style-type: none"> 1) Check Power Supply and Cables 2) Check Ethernet cables, switches, etc. 3) Set IP address with FLIR IP Config 4) Check Camera operations
Camera connection lost during normal operation after working previously.	<ol style="list-style-type: none"> 1) Camera Power cable broken 2) Ethernet cable broken 3) Camera Software Fault 4) Camera Hardware Failure 5) Camera thermal issue (overheating) 	<ol style="list-style-type: none"> 1) Check Power Supply and Cables 2) Check Ethernet Cable 3) Power-cycle the Camera 4) Check Camera operations 5) Power down and allow to cool.
<p>A) Camera connection appears to be OK, but no image appears.</p> <p>B) Camera image is blank and/or the camera temperature range is much higher than expected.</p>	<ol style="list-style-type: none"> 1) Camera temperature range is not properly set*. 2) Camera Software Fault 3) Camera Hardware Failure <p>*NOTE: This may happen if the camera Ethernet connection is unplugged while the camera is running.</p>	<ol style="list-style-type: none"> 1) Set correct Camera Configuration in FLIR IR Monitor or web browser 2) Power-cycle the Camera 3) Check Camera operations
Camera images appear as expected, but no output signal is generated.	<ol style="list-style-type: none"> 1) IR Monitor Recipe Configuration Error 2) Output line connection fault 3) I/O Module Error or hardware failure 	<ol style="list-style-type: none"> 1) Verify Output Channel parameters are set correctly on the MIO Utility's Script Commands tab 2) Check Output signal wiring 3) Verify Output signal using a volt meter or 4-20mA loop tested
Analog output current is unaffected by camera input.	<ol style="list-style-type: none"> 1) Analog channel is reading from incorrect camera (in multi-camera configurations) 2) Camera connection issue (See above) 3) MIO Device test current dip switches are enabled 	<ol style="list-style-type: none"> 1) Verify proper camera selection on the MIO Utility's Script Commands tab 2) Verify camera connection on the MIO Utility's Camera Settings tab 3) Move dip switches 3 and 4 on the MIO device to the OFF position

MIO Setup Issue	Possible Causes	Recommended Action
Unable to log in to the MIO Device Configuration Utility	<ol style="list-style-type: none"> 1) No Ethernet Connection to MIO Device 2) Incorrect IP Address 3) Incorrect Password 	<ol style="list-style-type: none"> 1) Check Ethernet cables, switches, etc. 2) Reset IP address to Default (Recovery Mode) 3) Reset Access Password (Recovery Mode)
Unable to access Camera Configuration items in the Script Commands tab	<ol style="list-style-type: none"> 1) No Ethernet Connection to the camera 2) IR Monitor Camera Configuration not complete 3) IR Monitor Camera Configuration error 	<ol style="list-style-type: none"> 1) Check Ethernet cables, switches, etc. 2) Verify Regions are set correctly in the FLIR IR Monitor application 3) Verify Regions are set correctly in the FLIR IR Monitor application
Device is unresponsive after firmware update	<p>Updated firmware is invalid</p> <p>MIO Device was interrupted during update</p> <p>Firmware binary file is corrupted</p>	<p>Reboot the device in Recovery mode, and try updating the firmware again</p> <p>If the device is still unresponsive, try updating to a previous working version of the firmware</p> <p>Contact MoviTHERM support.</p>

Output Issue	Possible Causes	Recommended Action
Digital Output voltage when off is too high	The attached load's resistance is too high	Install a pull down resistor in parallel with the load

9 Appendix A: Default Settings

Default Device Name:	"MIO -AX8-7"
Default Password:	password
Default Device IP Address:	192.168.1.2
Default Subnet Mask:	255.255.255.0

10 Appendix B: Technical Specifications

10.1 Absolute Maximum Ratings

Parameter		Min	Typ	Max	Unit
V _{in} – Input Power Voltage Range		10	24	30	VDC
P _{in} – Input Power		-	2.5	7	W
Vd _{in} – Digital Voltage In		9	24	30	VDC
Id _{out} – Digital Current	Single Channel	-	-	0.5	A
	All Channels	-	-	1.5	A
Digital inductive load switch-off energy dissipation		-	-	0.5	J
Operating Temperature		0	-	50	°C
Storage Temperature		-30	-	85	°C

10.2 Operating Specifications

Parameter	Min	Typ	Max	Unit
Output Current Error vs Temperature (-30°C to 85°C)		±0.3 ±98	±0.5 ±170	% ppm/°C
Analog Current Output Resolution		16		Bits
Digital Output On-State Resistance		0.16	0.4	Ω