MP113

Manager GUI Manual

TABLE OF CONTENTS

Before you Get Started 1
UART Cable Connection 1
Installing the MP113 Manager 3
General Restrictions when Using the MP113 Manager 3
First Time Start 3
The Main Screen 6
MP113 Configuration and Status Information 6
Single or Dual Color Print Head 8
MP113 Status Options 9
Tools Menu 9
MP113 Configuration 9
Current MP113 Operation Mode 10
Power On Options 10
Module I2C Address 10
D/A Offset Adjustment 11
Waveform Sanity Check 11
Waveforms 11
Creating and Editing Waveforms 12
Waveform Definition Table 13
Waveform Segment Settings 14
Function Buttons 14
Power Dissipation vs Print Frequency Tool 14
Scaling the Waveform 15
Firing Test Pulses 16
Test Patterns 17

© Apex Microtechnology Inc.
All rights reserved

INTRODUCTION

The MP113 Manager is a graphical user interface that permits configuration and test operation of the MP113 without a print data server. The MP113 Manager provides all functions required to successfully prepare the MP113 for its operation, including the definition of the output waveforms and the setup of its I2C address.

BEFORE YOU GET STARTED

A USB to serial converter cable is required for the MP113 Manager to communicate with the MP113. The components you need to build a cable are listed below.

Item	MFG Part #	Digikey Part #
USB to serial converter	UM232H	768-1103-ND
USB 2.0 cable, Type A to mini Type B	AK672M/2-1	AE1450-ND
24-30 AWG Wire		
Female connector terminal, 24-30 AWG	0016020096	WM2562-ND
Connector housing, 2x3, 100 mil	0022552061	WM2520-ND

UART CABLE CONNECTION

The MP113 Manager communicates with the MP113 through a serial communication link. The connector J5 (“CUST_PROG”) on the MP113 is used to connect an external digital UART to serial interface converter. The signals at J5 are as follows:

Pin Number	Name	I/O	Description
1	5V	-	5V Voltage. Do not connect if 5V is provided by the 64-pin card edge connector. Pin 1 of J5 is marked with a white dot on the board.
2	GND	-	Ground for UART signals (TXD, RXD). Also Ground to 5V if supplied on pin 1.
3	TXD	Output	Transmit data line. This is the output line for the MP113 and needs to be connected to the receive input of the external device.
4	RXD	Input	Receive data line. This is an input line to the MP113 and needs to be connected to the transmit output of the external device.
5	RFU		Reserved for future use. Don’t connect any signal to this pin.
6	RFU		Reserved for future use. Don’t connect any signal to this pin.

The figure below depicts the pin numbering of J5 when looking at the connector from the side.

Figure 1: J5 Pin Numbering

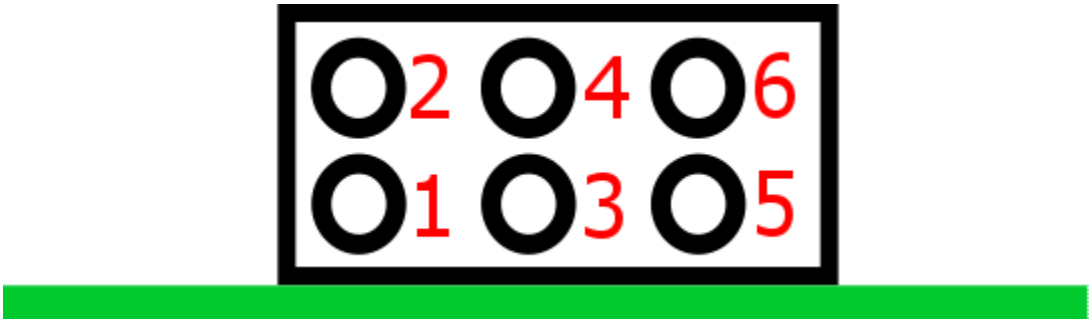
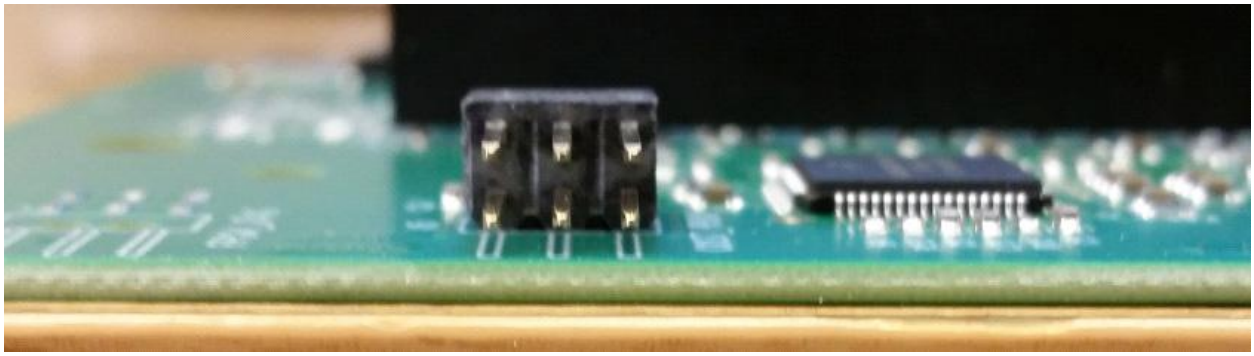
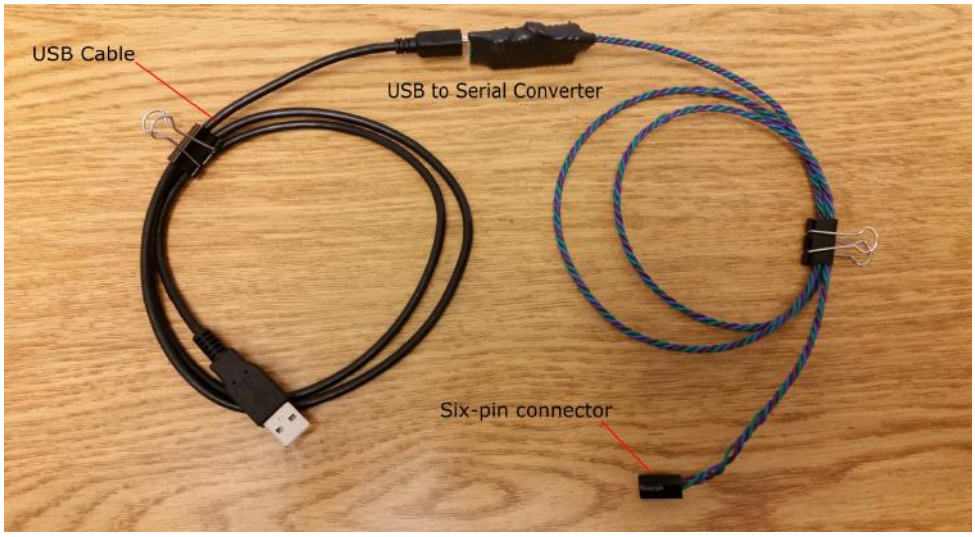


Figure 2: J5 Pins



MP113 requires a 5V voltage supply that can be either provided through the 64-pin card edge connector or through the J5 connector. Never connect a 5V voltage supply to both connectors at the same time to prevent any damage to the MP113.
The TXD and RXD signals at the J5 connector are digital signals that are not compatible to RS232 signals. Never connect the pins directly to a RS232 interface.
See figure below for a completed cable.

Figure 3: MP113 Completed Cable



INSTALLING THE MP113 MANAGER

The current MP113 Manager can be downloaded from Apex Microtechnology's website. If you use prototype versions of MP113 please contact Apex Microtechnology before you download and install the software to ensure that your prototype is compatible with the software provided on the website.

The current installer only works on the Windows™ operating system.

The software is provided with a self-installer which will guide you through the installation steps. By installing the software on your computer you agree to the terms and conditions provided in the licensing agreement that is shown to you at the beginning of the installation process. In particular you agree that the software is provided to you "as is" without any warranties or conditions of any kind. Please read through the sections "Limitation of Warranty" and "Limitation of Liability" for details.

GENERAL RESTRICTIONS WHEN USING THE MP113 MANAGER

MP113 Manager has run smoothly on all computers we tested (Windows XP, Windows 7), but it does not handle country specific localizations. That means that all file paths and file names need to use characters that are part of the latin1 font set (simplified, all 'A' to 'Z' in upper-case or lower-case letters, the numbers '0' to '9', and the '.' to separate file name and file extensions).

FIRST TIME START

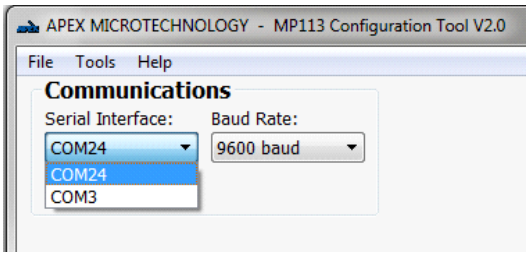
When connecting the MP113 to the PC for the very first time, it is recommended that you do not provide a high voltage ($+V_S$, $-V_S$) or the auxiliary voltage ($+V_{AUX}$) to the board. Also, do not connect a print head to the 60-pin card edge connector at that time. This allows you to get familiar with the MP113 Manager and its functionality without causing any unexpected outputs or high voltage signals. You do, however, need to connect a 5V voltage supply (V_{CC}) and ground.

There are two green LEDs on the board that will illuminate if the VCC supply is provided correctly:

Figure 4: V_{CC} (5V) LEDs

When starting the MP113 Manager on your computer, it will ask you for the serial communication interface that is connected to your MP113 board:

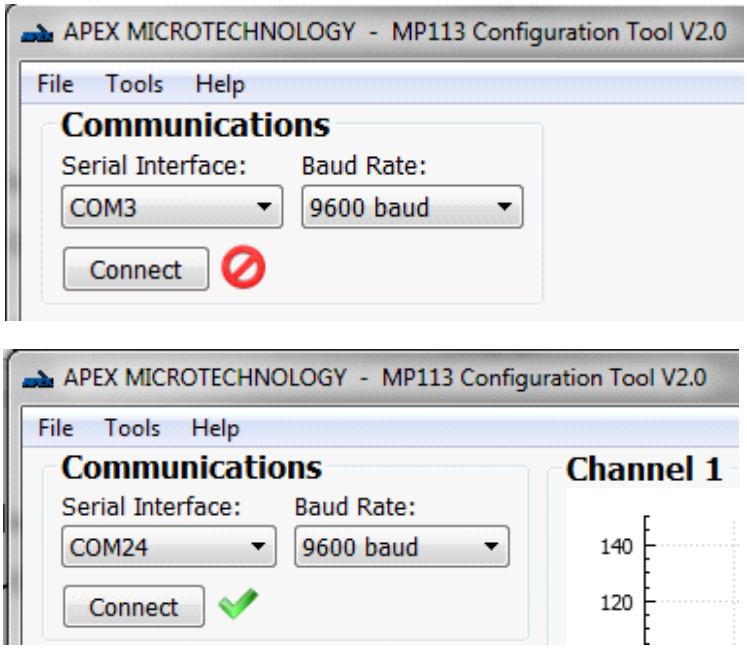
Figure 5: Serial Communication Setting



Please select the correct serial interface from the drop-down menu.

Confirm that proper communication can be established by clicking on the “Connect” button. The MP113 Manager will try to establish communication with the MP113 board. If successful, a green check mark (see, right) will replace the blue question mark shown in the initial screen, otherwise a red icon (see, left) will indicate that the communication failed:

Figure 6: Failed (above) and Successful (below) Communication



If communication is not possible, please check the following:

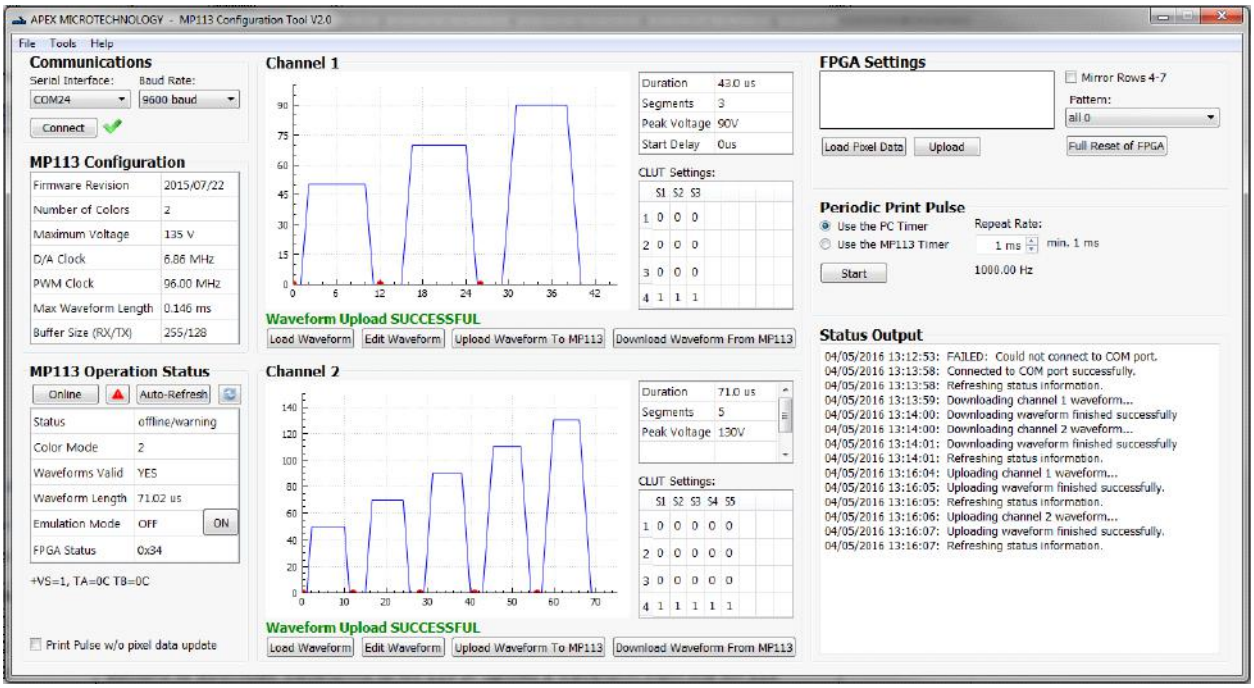
- Have you selected the correct serial communication interface in the software?
- Is 5V (V_{CC}) and Ground connected on the MP113 board?
- Is the MP113 board powered on? You should see a green LED light on the board
- Is there a connection between the PC ground and the MP113 ground?
- Are RXD and TXD lines of connector J5 connected properly? Is RXD connected to the transmit signal of the PC, and is the TXD connected to the receive signal of the PC?

If communication was successfully established, the MP113 manager will automatically enable the main screen.

THE MAIN SCREEN

The main screen of the MP113 Manager looks as follows:

Figure 7: Main Screen of MP113 Manager



When you start MP113, the main screen will not be visible. The main screen will become visible only after successful communication with the MP113.

MP113 CONFIGURATION AND STATUS INFORMATION

Most of the information in the MP113 Configuration and Status Information is provided for diagnostic purposes only. It is useful if you decide to develop your own communication software, i.e. when planning to use the I2C interface. However, all the information can also be read from the MP113. When developing your own communication software it is highly recommended that you read the configuration data directly from the MP113 instead of relying on the displayed data.

Item	Explanation
Firmware Revision	Date code of the current firmware built
Number of Colors	Maximum number of colors the MP113 can handle. Please also read the chapter “single or Dual Color Print Head”
Maximum Voltage	Maximum output voltage MP113 cab handle, provided that a proper supply voltage is provided. Please check the data sheet for details on the output voltage swing to determine the supply voltage headroom needed for the output voltage
D/A Clock	D/A converter update rate
PWM Clock	Internal operating clock of the waveform timer
Max Waveform Length	The maximum length of a waveform MP113 can output
Buffer Size (RX/TX)	Communication buffer size. This information is helpful if you decide to develop your own communication software

The Status Information is a current snapshot of MP113’s operation and will therefore change during the operation of MP113.

Item	Explanation
Status	“Offline” or “Online”. You can click the “Online” button to change the status. Note that MP113 can only go online if valid waveform data is available. MP113 ignores all input signals to the MP113 if it is either in offline mode or if emulation mode is active. MP113 only responds to requests for waveform output when in online mode.
Current Color Mode	Number of colors the MP113 currently handles. This can be the same or less than the maximum number of colors MP113 can handle. Please also read the chapter “Single or Dual Color Print Head”
Waveform Valid	No: MP113 does not have valid waveform data. If you have a MP113 that can handle 2 colors, you need to download waveform for both colors, even if MP113 is used in single color mode. MP113 can’t go online if no valid waveform data is found. Yes: MP113 has valid waveform data.
Waveform Length	Length of the current waveform. If you have a MP113 that can handle 2 colors, this is the longer of the two waveforms.
Emulation Mode	Off: MP113 is controlled by the input signals to the MP113 board (card edge connector) On: MP113 ignores all input signals to the MP113 board. It is controlled by the graphical user interface only. When “Emulation Mode” is on and MP113 Operation Status is “Online”, the print pulse button appears below this table.
FPGA Status	Coded Information on the FPGA status. This is provided for diagnostic purposes only.
Refresh Button	Update the MP113 Status information
+VS, TA,TB	MP104 temperature sensor in degrees Celsius. Supply voltage information in Volts.

SINGLE OR DUAL COLOR PRINT HEAD

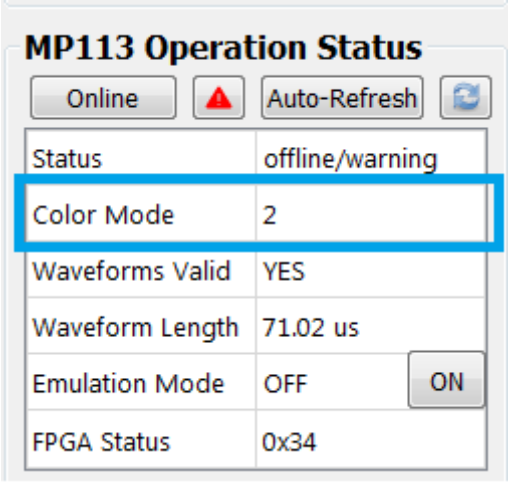
MP113 is designed to work with SG-1024 print heads from Fujifilm Dimatix. It supports both the single and dual color versions:

Figure 8: SG-1024 Print Heads: Dual Color (left) and Single Color (right)

When starting the MP113 Manager for the very first time you need to confirm that MP113 is configured for the print head you are planning to use. The factory default setting for color mode is dual color.

Under the "MP113 Operation Status", there is a line item "Color Mode". That number should match the number of colors your print head can handle. If you have the dual color version of the SG-1024, it should read "2", if you have a single color version then the value should be "1". Figure 6 has the line item marked in blue.

Figure 9: MP113 Current Color Mode



To change the number of colors, you need to re-configure the MP113. Check the "Number of Colors" line under the "MP113 Configuration". Go to the section titled "Current MP113 Operation Mode", which describes how to change the MP113's color mode.

MP113 STATUS OPTIONS

MP113 has three major modes:

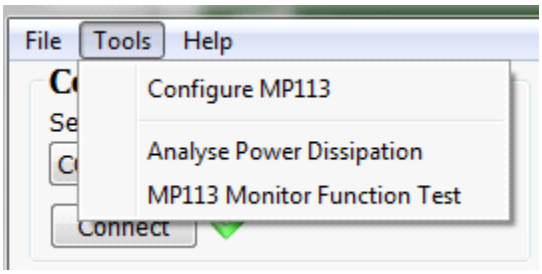
- Online mode.....MP113 is actively monitoring the incoming print signal and data clocks. MP113 is ready to output a waveform once it receives a print.

- Offline mode.....Also known as “configuration mode”. The MP113 output is set to 0V and any incoming print signal or data clock are ignored. In grayscale mode, the output data lines to the print head are pulled to GND signal, in binary mode the output data lines to the print head are still directly connected to the input data lines. The clock and latch signals are always pulled to GND.

- Emulation mode....Also known as “demo mode”. All input signals to the MP113 are replaced by input signals created through the MP113 Manager (this software).

TOOLS MENU

Figure 10: Tools Menu



The tools menu offers the following options:

- Configure MP113.....MP113 Configuration dialog – see description below for details

- Analyze Power Dissipation.....Power dissipation analysis tool using your waveform information

- MP113 Monitor Function.....Runs periodic monitoring of +VS power and channel temperature

MP113 CONFIGURATION

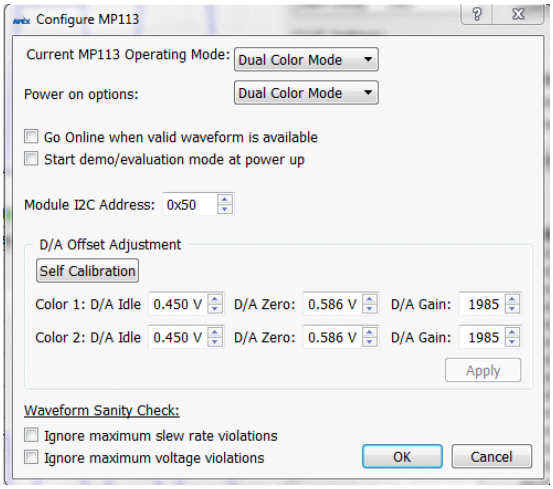
The configuration dialog of the MP113 Manager allows you to

- Set the MP113 operating mode
- Set the MP113 behavior after power-on
- Set the I2C address of the MP113

Configuration of the MP113 is done by clicking on “Tools” in the menu bar, then selecting “Configure MP113”:

The Configuration Dialog can only be started if MP113 is not online or if MP113 is in emulation (demo) mode.

Figure 11: MP113 Configuration Dialog



CURRENT MP113 OPERATION MODE

The “Current MP113 Operating Mode” shows the mode of the MP113. This field can only be changed if MP113 is offline. Valid operation modes are:

- Binary Mode
- Single Color Mode
- Dual Color Mode (only available for the 2-color version of MP113)

Please refer to the MP113 Data Sheet for the details on the operating modes. If you want to change the operation mode select the new mode from the pull-down menu and click OK.

Changing the “Current MP113 Operation Mode” will not change the startup mode of the MP113. If you want to permanently change the mode of MP113, you need to change the “Power On Option” at the same time.

POWER ON OPTIONS

The “Power on Options” allow you to select the behavior of MP113 at power-up. Besides selecting the operation mode, you can also define if the MP113 is set to demo/evaluation mode.

The status of MP113 (online/offline) can be controlled through the serial communication interface at any point in time. If you need some time to set up the other components of your system before MP113 can receive printing information, you should keep MP113 offline after startup. Once your initialization of the system is complete, you issue MP113 the command to go online through the serial communication interface.

MODULE I2C ADDRESS

The MP113 Configuration Dialog also allows you to set the I2C address of the module. Please select the proper value in the related input box. By default, MP113 has the I2C address of 0x50 (hex). A change in the I2C address become active immediately after clicking the OK button.

D/A OFFSET ADJUSTMENT

The “Self Calibrate” functionality of the MP113 uses the value of the +VS supply to calculate the ideal gain and offset of the amplifier.

Unless explicitly told otherwise by Apex personnel, only use the “Self Calibrate” for adjusting the D/A converter. Adjusting the D/A values manually can result in potential damage to the print head.

WAVEFORM SANITY CHECK

The MP113 Manager checks the waveform for their peak voltage and their slew rate. If you want to use slew rates that exceed the maximum slew rate MP113 is guaranteed to handle properly you can do so at your own risk by disabling the slew rate check of the waveforms.

WAVEFORMS

The MP113 Manager can read waveforms that were created by Fujifilm’s waveform creator tool, or you can use the MP113 Manager to create and edit your own waveform.

If your MP113 already has waveforms loaded, you can request the MP113 Manager to download the waveforms from the MP113.

If you created a waveform and saved it to a file, or if your print head manufacturer provided you with a waveform, you can click on “File” in the menu bar and select “Load Waveform”. A file selection dialog will open. Select the waveform file there and click okay. If you selected a valid waveform file, the waveform will be displayed in the waveform display.

If you need to start creating a new waveform, you need to click on “File” in the menu bar. Then select “Edit Waveform”. A new dialog window will open that provides you with all the tools to create and/or edit a waveform.

To upload a waveform to the MP113, click on the “Upload Waveform to MP113” button. The MP113 Manager will send the waveform to the MP113. All waveforms will automatically be stored in non-volatile memory on the MP113, so any waveform uploaded to the MP113 is still available after a power cycle.

MP113 has some restrictions about waveforms. Before uploading a waveform, the MP113 Manager will check the waveform thoroughly for potential violations. The table below provides a list of violations and steps to fix them. You can use the edit waveform function within the MP113 Manager to adjust the waveform.

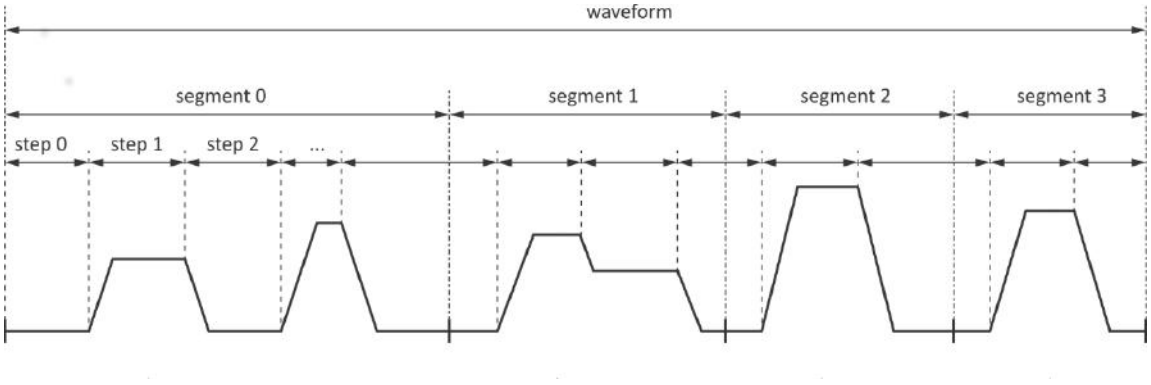
Violation	Solution
No waveform loaded	Load a waveform or create a waveform before clicking the upload button
No pulse defined	A waveform needs to have at least one pulse. Edit the waveform and add the pulse information
No waveform defined	A waveform needs to have at least one voltage that is not 0. Edit the waveform and add a voltage level that is not zero.
Invalid segment start times	Start times must be in sequential order and within the duration of the waveform. Edit the waveform and correct the segment start times
Segment length is too short	The time between two segment markers or between the last segment marker and the end of the waveform needs to be at least 10µs (see MP113 data sheet). Edit the waveform and either adjust the segment markers and/or increase the length of the step(s) within a segment.

Waveform too long	The length of the waveform exceeds the memory of the MP113. The MP113 Configuration and Status Information shows the maximum length of a waveform. Edit the waveform and shorten it accordingly.
Slew rate too fast	The slew rate of the waveform is faster than the maximum slew rate defined in the MP113 data sheet. Edit the waveform and adjust the slew rate. Note: You can disable the slew rate sanity check at your own risk in the MP113 configuration dialog
Peak voltage is too high	The peak voltage of the waveform is greater than the maximum output voltage of the MP113. The MP113 Configuration and Status Information shows the maximum output voltage of the MP113. You can either use the “Adjustment of the Peak Voltage” on the main window (item 4) to correct the peak voltage, or for enhanced voltage adjustment options you can edit the waveform and adjust the peak voltage there.
Waveform does not end at 0V	All waveforms need to end at 0V. Edit the waveform and add a step that drops the voltage back to 0V.
Waveform step too short	All waveform steps need to be at least the duration of one D/A converter update, which is shown in the MP113 Configuration and Status Information. Edit the waveform and ensure that all steps meet the minimum time requirement
Slew rate too slow	The slew rate for one or several steps in the waveform is too slow to allow the output to reach its target voltage before the start of the next section. Edit the waveform and adjust the slew rate, the voltage or the length of the section(s).
Voltage is not 0V at segment marker	Segment markers can only be set for periods where the output voltage is 0V. Edit the waveform and adjust the segment markers.
Two consecutive steps have the same voltage	Each step needs to have a different output voltage. Edit the waveform and combine steps with the same output voltage.

CREATING AND EDITING WAVEFORMS

Before explaining the waveform editor of the MP113 Manager, the common expressions used in this chapter are explained:

Figure 12: Waveform, Segment, Steps

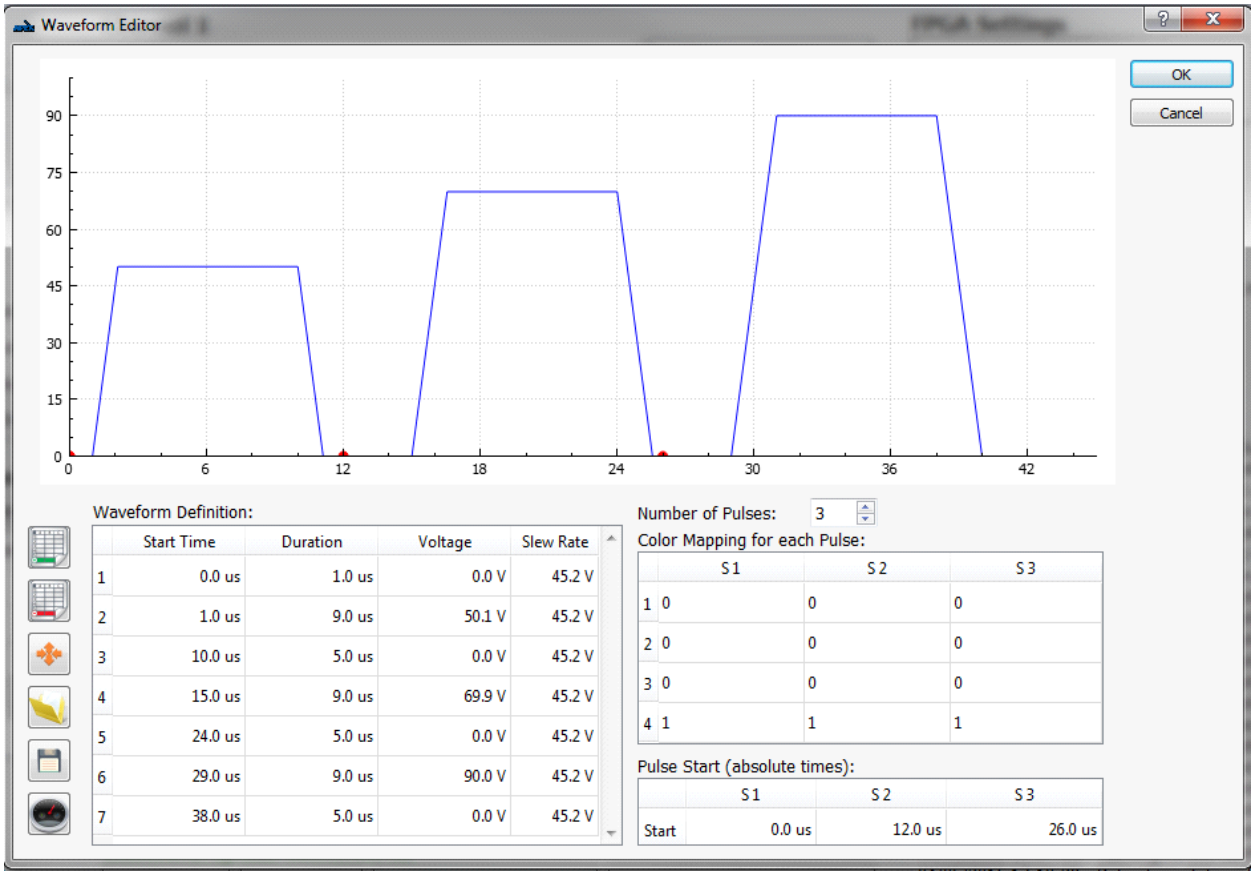


- Step.....Period where the output is set to a defined voltage. All steps include the rise or fall time to the output voltage. Every step needs to end at a different voltage level than its start voltage. The very first step must start at 0V, the very last step needs to end at 0V.

- Waveform.....Combination of all steps that form an output.

• Segment.....Period within the waveform. All segments must start at 0V and end at 0V. Besides the restriction that the first segment starts with step 0 and that the last segment ends with the last step, the start and end times of segments can be set arbitrarily as long as the 0V restriction is met.

Figure 13: Waveform Editor Dialog



WAVEFORM DEFINITION TABLE

The waveform definition table is used to create and edit the displayed waveform. The start time of each step is calculated automatically. Other values such as duration, output voltage and slew rate can be manually changed.

Table Column	Description
Start Time (micro-seconds)	Start time of the step. This value is calculated automatically and updated whenever a duration is changed.
Duration (micro-seconds)	Duration of the step. The duration is total time of the step: the slewing plus the hold period.
Voltage (Volts)	Output voltage at the end of the step. If lower than the previous step, the waveform will slew down (falling edge), otherwise it will slew up (rising edge).
Slew Rate (Volts/ microsecond)	Slew rate to move from the voltage of the previous step to the voltage of the current step.

WAVEFORM SEGMENT SETTINGS

MP113 supports waveforms from 1 to 8 segments. The number of segments is set by the “Number of Pulses” box.

The color mapping table links the 4 grayscale color levels to the waveform segments. Each row describes a color level, levels 1 – 4. Each column represents a waveform segment. The color map in each section of the table can be set to 1, ON, or 0, OFF.

The segment start times are defined in the table shown as item 5. The very first segment always starts at 0 µs. All other segment starts can be adjusted. Please note that the duration of any segment must meet the minimum waveform duration requirement of MP113, which is 10 µs.

FUNCTION BUTTONS

Adds a new step to the waveform definition table

Removes the marked step from the waveform definition table

Scale the waveform. Scaling can be either done by adjusting the slew rate or the peak voltage. An explanation of the scaling dialog is provided in this document

Open a waveform from a spreadsheet file

Save the waveform to a spreadsheet file

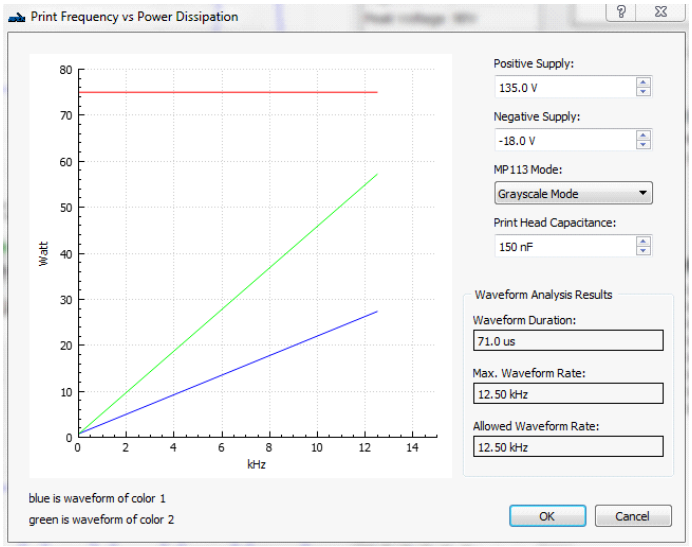
Start the power dissipation vs. print frequency analysis tool

POWER DISSIPATION VS PRINT FREQUENCY TOOL

This tool provides a rough estimation of the power dissipated by the MP113 during print cycles. Enter power supply information and the print head capacitance. The graph will plot the average power dissipated from the minimum to maximum frequency permitted for each waveform. The red line indicates the maximum power dissipation the MP113 can handle.

The power calculated by the power dissipation tool is a rough estimate only! Printer manufacturers must make appropriate calculations using their own tools.

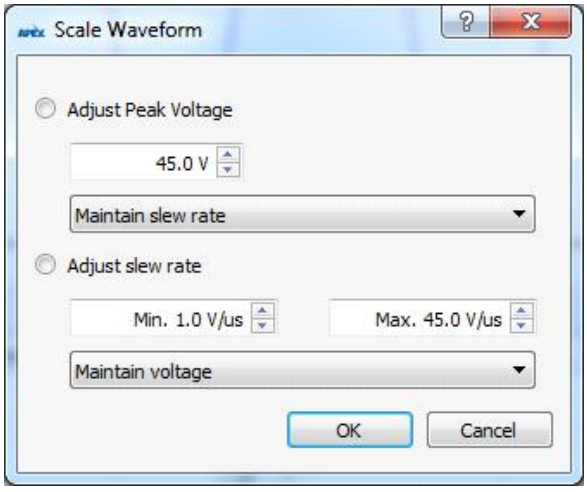
Figure 14: Print Frequency vs Power Dissipation



SCALING THE WAVEFORM

The waveform editor provides a function to adjust either the slew rate or the peak voltage without editing each and every step of the waveform. When you click the function button in the icon bar, a new dialog window opens.

Figure 15: Scaling Waveform Options



When adjusting the peak voltage, all voltages that are not zero are adjusted based on the following formula:

$$V(new) = V(old) \times \frac{V_{Peak}(new)}{V_{Peak}(old)}$$

Scaling	Option	Explanation
Adjust Peak Voltage	Maintain slew rate	When adjusting the peak voltage, the slew rate remains untouched. That means that the rise and fall times extend or shorten, impacting also the duration where the target voltage is available. $SR(new) = SR(old)$
	Maintain rise time	When adjusting the peak voltage, the duration of the target voltage remains untouched, so the slew rate is adjusted. $SR(new) = SR(old) \times \frac{V_{Peak}(new)}{V_{Peak}(old)}$

When adjusting the slew rate, you need to provide a range of acceptable slew rates. If you want all slew rates to be the same, set the min and the max slew rate to the same value.

Slew rates (and target voltages, if impacted) are only changed if they are outside the range provided by the min and max slew rate field. If the slew rate is already in the allowed range, no changes need to be made.

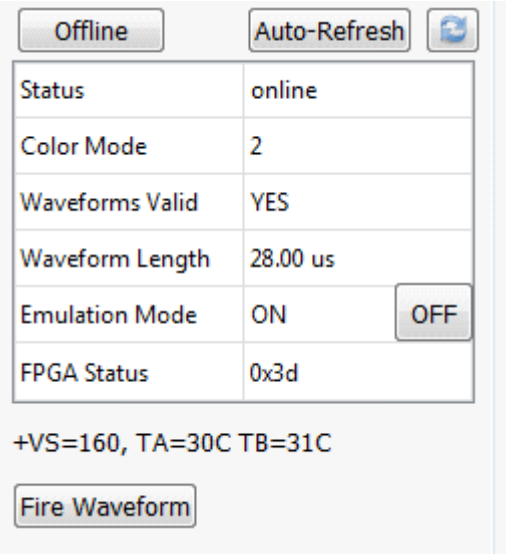
Scaling	Option	Explanation
Adjust Slew Rate	Maintain voltage	When adjusting the slew rate, the target voltage remains untouched. That means that duration of the target voltage changes.
	Maintain rise time	When adjusting the slew rate, the target voltage is scaled accordingly so that the duration of the voltage remains untouched: $V(new) = V(old) \times \frac{SR(new)}{SR(old)}$

FIRING TEST PULSES

After all waveforms are uploaded, the MP113 can be fired manually from the GUI.

Ensure all power supplies are turned on. Turn on emulation mode, then select the Online button. The GUI operation status menu should appear similar to the figure below. When ready, press the “Fire Waveform” button.

Figure 16: MP113 Operation Status



TEST PATTERNS

The MP113 Manager provides various pre-defined test patterns for testing the behavior of the print head under the selected voltage and waveform. In addition, a user-defined test pattern can be loaded from a spreadsheet file.

The test pattern output is only available while MP113 is in emulation mode.

In order to output a test pattern, select a test pattern and upload it to the MP113 before clicking the “Print Pulse” button.

After uploading the test pattern to the MP113 you must hit the “Print Pulse” button twice before you select a repeated print pulse output. Otherwise the uploaded test pattern will have no or only a partial effect.

A custom test pattern is a spreadsheet with up to 128 columns and up to 8 rows. Each cell in that spreadsheet represents a nozzle. You can enter a grayscale intensity value of 0 - 3 in any cell. If a cell is blank, a 0 value is assumed. The spreadsheet can be either comma separated (.csv) or an Excel Spreadsheet (.xlsx) file.

To load a custom test pattern, click on “File” in the menu bar, then select “Load Test Pattern”.

NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

For all Apex Microtechnology product questions and inquiries, call toll free 800-546-2739 in North America. For inquiries via email, please contact apex.support@apexanalog.com. International customers can also request support by contacting their local Apex Microtechnology Sales Representative. To find the one nearest to you, go to www.apexanalog.com

IMPORTANT NOTICE

Apex Microtechnology, Inc. has made every effort to insure the accuracy of the content contained in this document. However, the information is subject to change without notice and is provided "AS IS" without warranty of any kind (expressed or implied). Apex Microtechnology reserves the right to make changes without further notice to any specifications or products mentioned herein to improve reliability. This document is the property of Apex Microtechnology and by furnishing this information, Apex Microtechnology grants no license, expressed or implied under any patents, mask work rights, copyrights, trademarks, trade secrets or other intellectual property rights. Apex Microtechnology owns the copyrights associated with the information contained herein and gives consent for copies to be made of the information only for use within your organization with respect to Apex Microtechnology integrated circuits or other products of Apex Microtechnology. This consent does not extend to other copying such as copying for general distribution, advertising or promotional purposes, or for creating any work for resale.

APEX MICROTECHNOLOGY PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN PRODUCTS USED FOR LIFE SUPPORT, AUTOMOTIVE SAFETY, SECURITY DEVICES, OR OTHER CRITICAL APPLICATIONS. PRODUCTS IN SUCH APPLICATIONS ARE UNDERSTOOD TO BE FULLY AT THE CUSTOMER OR THE CUSTOMER'S RISK.

Apex Microtechnology, Apex and Apex Precision Power are trademarks of Apex Microtechnology, Inc. All other corporate names noted herein may be trademarks of their respective holders.