

MIPS Control Panel Timing Generator

Overview

December 3, 2018

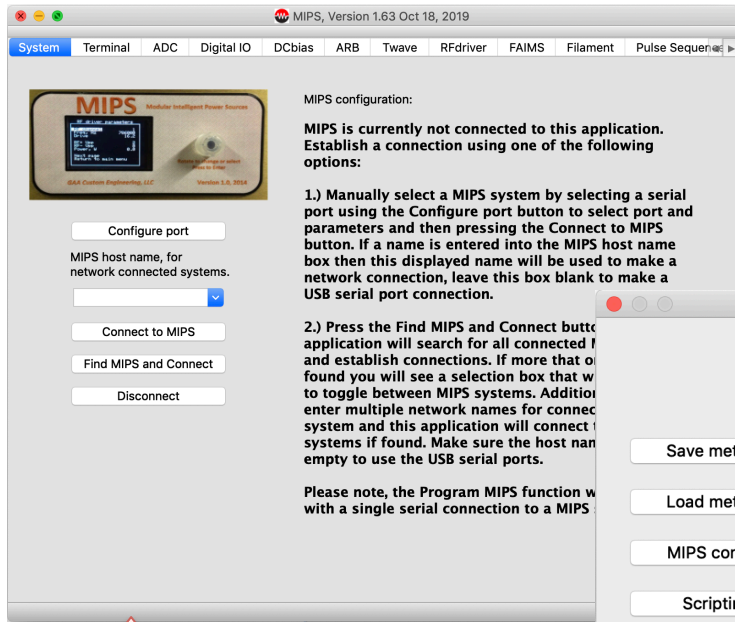
Revised May 19, 2019

Revised October 20, 2019

Revised March 30, 2020

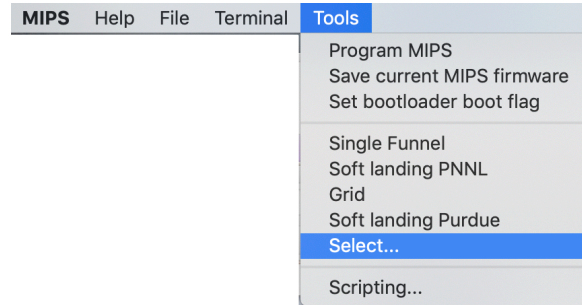
Loading MIPS Control Panels

MIPS main startup dialog



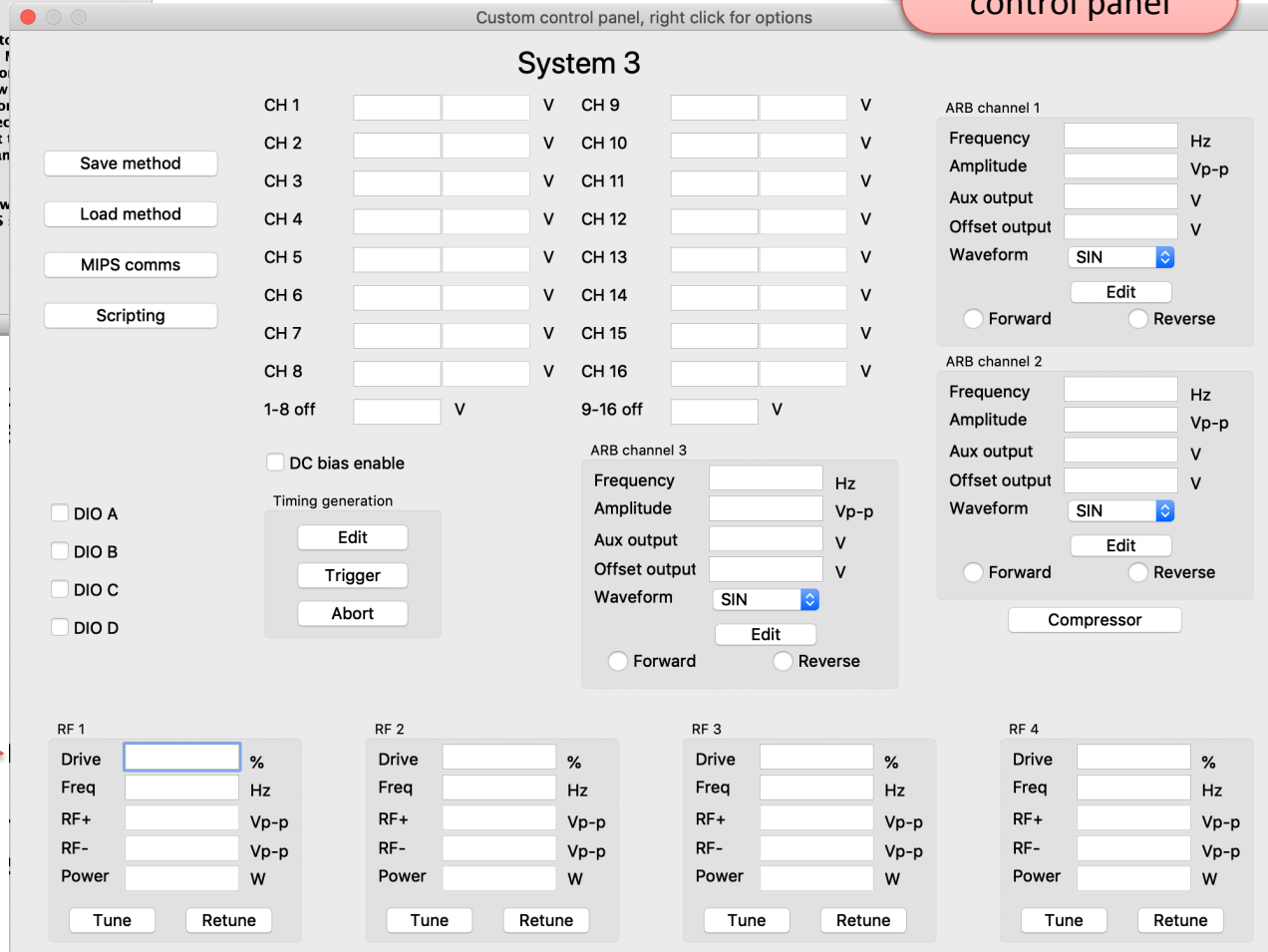
MIPS host application, supports PC, MAC and Linux

Example control panel, these are easy to customize based on your system. When the control panel loads the MIPS main dialog will minimize.



MIPS menu

Select this option to select a .cfg file that will load a control panel



Control panel loaded: Sun Oct 20 18:36:43 2019

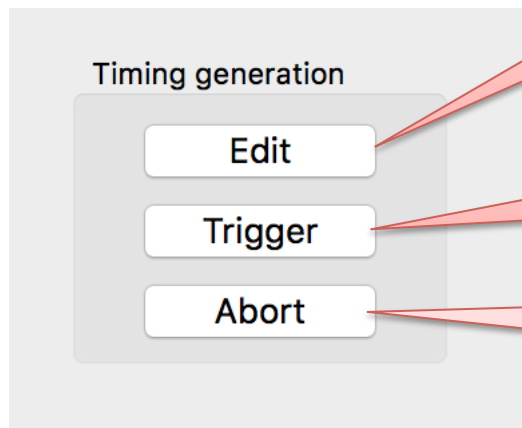
Control panel Interface

Adding the following command to the control panel configuration file will enable the timing generation function discussed in this document:

`TIMING,Timing generation,MIPSname,X, Y`

MIPSname is the name of the MIPS system where this timing control will be applied. X and Y define the location of the control.

This is the dialog you will see on your control panel.



Press this button to popup a dialog box to allow editing the pulse sequence

Press this button to trigger the pulse sequence and start a data acquisition

Press this button to stop an acquisition that is in progress

Pulse sequence editor

This section allows you to define an event in the pulse sequence. You can have as many events as needed in a pulse sequence.

This button will clear all events and allow you to start a new sequence.

This section defines clock and triggering options.

This button will use the current settings to generate a pulse sequence and display it in the table box.

This section defines the data collection frame, the number of accumulations and allows defining an Enable output signal if needed.

These buttons allow you to load and save pulse sequences to a data file.

The screenshot shows the 'Timing generation editor' window. It features several sections: 'Select event' with a dropdown menu; 'Event editor' with fields for Name, Signal, Start, Width, Value, and Value, off; 'Frame parameters' with fields for Start, Width, Accumulations, and an Enable dropdown; 'Time mode, in mS' with a checkbox and fields for Ext Clock Freq, Clock source, Trigger source, and Mux order; and buttons for 'Generate', 'Load', and 'Save'. A 'Table' section at the bottom has an empty text box. Red callout boxes with arrows point to various parts of the interface, providing explanations for their functions.

Timing generation editor

Select event

Clear all events

Time mode, in mS ☐

Ext Clock Freq

Clock source

Trigger source

Mux order

Generate

Load Save

Event editor

Name

Signal

Start

Width

Value

Value, off

Frame parameters

Start

Width

Accumulations

Enable

Table

Pulse sequence editor

Event definition

Name of the selected event.

Allows you to define a new event, select an existing event, or delete an existing event

This is the signal this event defines. This list is automatically populated from the available options.

Starting point (in clock cycles) for this event in the pulse sequence.

Width (in clock cycles) of this event.

Output value for this event when its active

Output value for this event when its inactive

The screenshot shows the 'Timing generation editor' window. It features a 'Select event' dropdown menu, a 'Clear all events' button, and a 'Time mode, in mS' checkbox. The 'Event editor' section contains fields for 'Name', 'Signal', 'Start', 'Width', 'Value', and 'Value, off'. The 'Frame parameters' section includes 'Start', 'Width', 'Accumulations', and 'Enable' fields. The right side has 'Ext Clock Freq', 'Clock source', 'Trigger source', and 'Mux order' dropdowns, along with 'Generate', 'Load', and 'Save' buttons. A 'Table' field is at the bottom.

Event editor	Frame parameters	Global settings
Name	Start	<input type="checkbox"/> Time mode, in mS
Signal	Width	Ext Clock Freq: 6135
Start	Accumulations	Clock source: Ext
Width	Enable	Trigger source: Software
Value		Mux order: None
Value, off		Generate
		Load Save

Define as many events as needed. You can have multiple events with the same start and width values. The event name must be unique.

Pulse sequence editor

Frame parameters

The Frame parameters define the total length to the frame and the number of cycles the pulse sequence will repeat.

Defines the start point (in clock cycles) of the data acquisition frame in the pulse sequence.

The screenshot shows a software window titled "Timing generation editor". It contains several sections: "Select event" with a dropdown menu and a "Clear all events" button; "Event editor" with fields for Name, Signal, Start, Width, Value, and Value, off; "Frame parameters" with fields for Start, Width, Accumulations, and an Enable dropdown; and a right-hand panel with "Time mode, in mS" (unchecked), "Ext Clock Freq" (6135), "Clock source" (Ext), "Trigger source" (Software), "Mux order" (None), a "Generate" button, and "Load" and "Save" buttons. A "Table" section is at the bottom left. Red callout boxes point to specific fields: one to the Start field, one to the Width field, one to the Accumulations field, and one to the Enable dropdown.

Frame parameters	
Start	10
Width	2000
Accumulations	10
Enable	<input type="checkbox"/>

Data acquisition frame width
(in clock cycles).

This is the number of
accumulations or cycles for
this pulse sequence.

This option allows you to
define an output logic signal
that will signal the acquisition
interval.

Pulse sequence editor

Clock and trigger options

Pulse sequences can be defined in clock cycles or time in mS. Check this box if you wish to enter the parameters in mS.

If you have selected time mode and your using an external clock then this box allows you to define the external clock frequency in Hz. This is needed to calculate the time in mS.

Defines the clock used by the pulse sequence generator:
Ext uses the Clk input.
ExtN used the negative edge of the Clk input.
ExtS uses the S input.
There are also a number of internal clock frequency options.

Define the trigger option used to start a pulse sequence.
Options include:
Software
External Trg input on the Pos edge, Neg edge, or Edge for any edge.

The pulse sequence generator supports generation of Hadamard multiplexing bit sequences. Use this option to select the desired option.

The screenshot shows the 'Timing generation editor' window. It has a title bar with standard OS window controls. The main area is divided into several sections: 'Select event' with a dropdown menu and a 'Clear all events' button; 'Event editor' with fields for Name, Signal (dropdown), Start, Width, Value, and Value, off; 'Frame parameters' with fields for Start, Width, Accumulations, and an Enable checkbox; and a right-hand panel with 'Time mode, in mS' (checkbox), 'Ext Clock Freq' (text box with '6135'), 'Clock source' (dropdown with 'Ext'), 'Trigger source' (dropdown with 'Software'), 'Mux order' (dropdown with 'None'), a 'Generate' button, and 'Load' and 'Save' buttons. At the bottom is a 'Table' section with an empty table.

Note: The count values in the start and width boxes of the events and frame parameters can contain fixed numbers representing total counts or time and can also contain references to other event start and width values. For example if you define an event named ACC and it has a start count of 100 you can then define another event or frame parameter start or width as $25 + \text{ACC.Start}$. You can use both + and – operators. This allows you to link events in a logical way so changing one event's value will redefine other event in a logical way for your application.

Example pulse sequence

- In this example we generate a generic pulse sequence. This sequence consists of four main events:
 - Fill time
 - Trap time
 - Release time
 - Inject time
- For each of these events we define a start and width time and well as a signal to control. The signal is optional and it can be left blank. If the signal is selected then its active and off values need to be defined.
- In this example we will focus on the event's start and width values. This sequence is defined in a way that the user only need to edit the Inject time to define where in the sequence the injection occurs, all the events are linked. Below is a table of event start and width values to illustrate the capability:

Event name	Start	Width
Fill time	Trap time.Start-Fill time.Width	100
Trap time	Inject time.Start-Trap time.Width	10
Release time	Inject time.Start	20
Inject time	200	9

- In this example the user only needs to adjust the width values for the first three events and the Inject time Start. I have not shown the signals that are controlled, this will depend of your system, also Trap time does not control a signal, it represents a delay while the ions are held in the trapping region.

Hadamard multiplexing

- Generation of a Hadamard multiplexing pulse sequence requires first the generation of the injection event. The following events must be defined as outlined in the example pulse sequence:
 - Fill time
 - Trap time
 - Release time
 - Inject time
- When the pulse sequence is generated all the injection times are calculated based on the bit order, then the above four events are used to calculate each injection event.
- Events defined in the pulse sequence with any other event names are used as defined and can control other aspects of the experiment.
- Please note, the Injection time event's start time must be set to zero