Introduction

The Pro Tesla MIDI 2.0 controller is designed as a stand-alone universal MIDI interrupter solution for our full range of musical Tesla coils including the Plasmasonic Musical Tesla coil systems as well as all of our DIY musical Tesla coil kits. The MIDI 2.0 is also compatible with almost all other DRSSTC type Tesla coils that have an ST fiber optic interrupter input.

The MIDI 2.0 controller is designed to be used as a stand-alone handheld MIDI interrupter or it can be hard mounted in permanent installations or control panels as a triggered MIDI source. As a handheld MIDI interrupter, it can easily be powered via a 9V battery or via a standard 12VDC power supply inside a control panel for permanent installations. MIDI files are stored directly on a removable SD memory card. The SD memory card can store up to 32 MIDI files if needed, although the typical number is generally between 10 and 20 MIDI files for most applications. Each MIDI file can be triggered via the onboard trigger pushbutton or through an external contact switch such as a pushbutton, relay, or PLC relay output. Each time the MIDI 2.0 controller is triggered, the controller will advance to the next MIDI file automatically until all MIDI files are played. At that time, the controller will start playing the MIDI files from the beginning again.

Features:

- Stand-alone musical Tesla coil controller – No laptop required
- Compatible with practically all DRSSTC Tesla coils that have an ST fiber optic interrupter input
- Operates from 5VDC to 12VDC
- Onboard trigger pushbutton
- (3) status LEDs
- External trigger (contact switch such as pushbutton, relay, or PLC output)
- SD card for storing MIDI files and changing user settings
- Constant duty cycle technology – provides a warm and full sound
- Polyphonic output – multiple notes can be output at a time
- ST fiber optic output
- Maximum duty cycle and pulsewidth set via configuration files on SD card
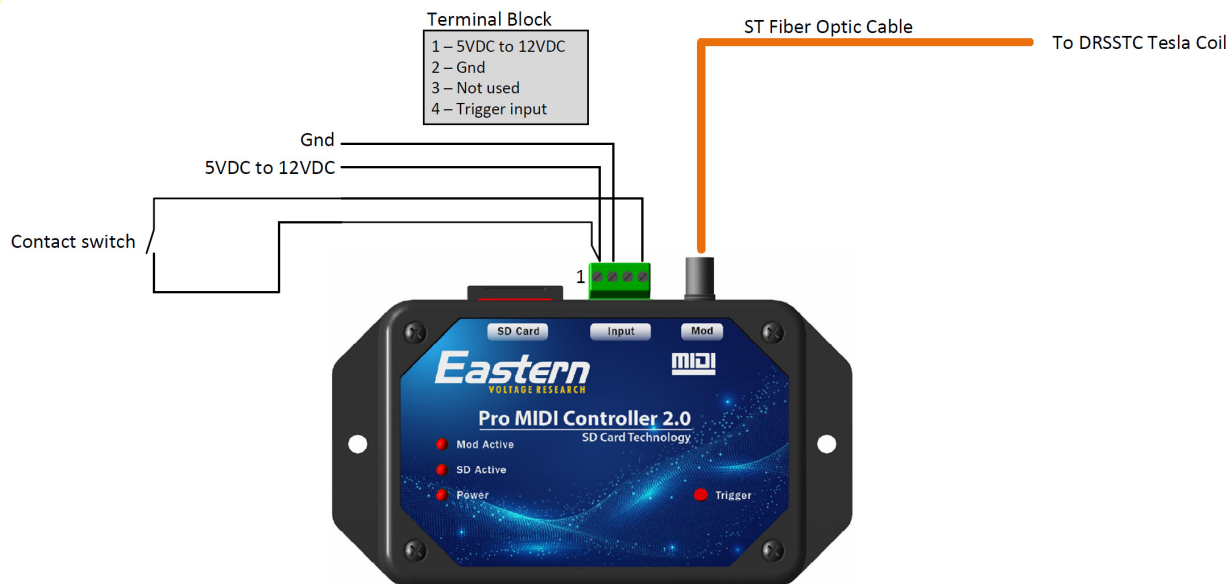- Flanged enclosure for easy mounting

Figure 1 – Typical Electrical / Fiber Connections

Electrical Connections

Standard electrical connections are shown in Figure 1 above. Note that the contact switch is basically any device such as a pushbutton or relay that can momentarily close contacts. Alternatively, a ground referenced 12V pulse can also be used as a trigger. Please contact technical support at Eastern Voltage Research for information on how to implement this mode of trigger.

Terminal block numbering begins at 1 on the left side of the terminal block as labeled above in Figure 1.

Terminal Block Pin #	Description
TB1-1	This is the positive connection from a power supply or battery. The acceptable range of input voltage is 5VDC to 12VDC. ⚠️ **Do not exceed 12VDC!**
TB1-2	This is the return (negative) connection from the power supply or battery.
TB1-3	Not used
TB1-4	This is the external trigger input to the controller. Acceptable connections would be a contact closure switch such as an external pushbutton, external relay contact, or PLC output relay contact. One side of the contact closure switch would be wired to TB1-1 as shown in Figure 1 above and the other side of the contact closure switch would be wired to this terminal, TB1-4.

Status LEDs

The following table provides descriptions for the three (3) onboard status LEDs.

Status LED	Function
Power	This LED will illuminate when input power is applied to the controller.
SD Active	When the controller is triggered either through the onboard trigger pushbutton or external contact closure switch, this LED will flash indicating that the MIDI file is being read from the SD card into the microprocessor memory.
Mod Active	This LED will illuminate whenever the output fiber optic is active and transmitting optical signals. Note that because the duty cycle of the output to a Tesla coil is relatively low and typically less than 10%, this LED will not be very bright when it illuminates. This is normal and to be expected.

Fiber Optic Cable

The fiber optic connector supports a fiber optic cable with ST type connectors. Fiber optic cables can be purchased directly through Eastern Voltage Research in a variety of lengths from 5M to 15M.

Fiber optic connectors are fragile and expensive to repair and replace. Please use special care when plugging in and removing fiber optic cables to the MIDI 2.0 controller.

Playback Operation

During each trigger, the MIDI 2.0 controller will play the next MIDI file in the folder list that is loaded in its directory. There will be a short pause between the trigger pause and playback of the MIDI file on the order of a couple of seconds. Each trigger will advance the MIDI file by one until it reaches the end of the MIDI file list at which time it will repeat back to the start of the first MIDI file. MIDI files are played alphabetically in order.

Playback STOP Function

New for 2023. If a 2nd trigger is received while the present MIDI song is playing, the song will be stopped and the song index will advanced to the next song. A new trigger will be required to start playback of the next MIDI file.

Constant Duty Cycle Technology

The MIDI 2.0 controller employs constant duty cycle technology. This means that any note or combination of notes played will never exceed the user programmed duty cycle limit. When a note is played, the MIDI 2.0 controller will first attempt to play the note at the maximum pulsewidth as defined by the user. Based on the audible frequency of the note being played and maximum pulsewidth, the duty cycle is calculated. If the calculated duty cycle of the note exceeds the maximum user programmed duty cycle limit, the controller will reduce the pulsewidth of the note until the maximum duty cycle is maintained.

Let's look at an example at how this works:

User Maximum Pulsewidth: 500us   (500 in the midi_max_pw.txt file)
User Maximum Duty Cycle: 5%   (500 in the midi_duty_max.txt file)

MIDI note: C5 (C above middle C)
MIDI note frequency: 523Hz

At 500us pulsewidth, the calculated duty cycle would be:

Duty Cycle = PW / Period   where Period = 1 / Frequency
Duty Cycle = 0.2615 or 26%

It can be seen that the user set maximum duty cycle is being violated here. Therefore, the new adjusted pulsewidth for this note would be reduced to approximately 100us which would result in a duty cycle of 5%.

File Structure

The following folder list shows the required files that are necessary on the SD card for the MIDI 2.0 controller to work properly. Note that the .map extension files are created automatically by the controller. A sample file SD card file list is available for download on the MIDI 2.0 controller product page.

midifile001.mid
midifile001.mid.map
midifile002.mid
midifile002.mid.map
midifile003.mid
midifile003.mid.map
…
midi_duty_max.txt
midi_max_pw.txt
next.txt

midifile001.mid – User uploaded midi file. This file should have a MIDI track set to channel 1. (Note: MIDI files may be arbitrarily named to anything you would like. They are only named midifilexxx as an example here.) Files are played in alphabetical order.

midifile001.mid.map – The MIDI 2.0 controller will automatically create .map extension files when the files are load and the MIDI 2.0 controller is powered up.

midi_duty_max.txt – This sets the maximum duty cycle in duty cycle % x 100. If you want to set the maximum duty cycle to 5%, the value would be 500. If you wanted to set the maximum duty cycle to 10%, then the value would be 1000 and so forth.

Acceptable duty cycle range is values 50 to 2500 (0.5% to 25%)
Entering values outside of this range may damage your Tesla Coil!

midi_max_pw.txt – The value in the file sets the maximum pulsewidth in microseconds (us). For example, the value 300 would be equivalent to 300us.

Acceptable pulsewidth range is values 50 to 10000 (50us to 10000us)
Entering values outside of this range may damage your Tesla Coil!

next.txt – This file is used internally by the microprocessor for indexing the playlist. When uploading new files to the SD card, it is important to ALWAYS set the value in this file to 1.

Recommend Starting Values

For a basic CM300 half-bridge system such as the Plasmasonic 1.3 Musical Tesla coil, Reference Design 1.0, or Best DIY Tesla Coil 6.0, the following values have been tested and verified as good starting points.

Max Pulsewidth – 500us
Max Duty Cycle – 500 (5%)

If you are using something other than the specific Tesla Coils above, it is always best to start with low value pulsewidths and duty cycles and gradually work your way up. Values such as 100us and 200 (2%) duty cycle would be good starting points.

High values for pulsewidth and duty cycles may damage your Tesla coil. Start with low values and work your way up until you get the desired results. Never start with high values!

Proper MIDI Files

MIDI files need to be specially edited for use with Tesla coils. You cannot use downloaded MIDI files from the internet. They must be properly edited and assigned to MIDI channel 1 for use with the MIDI 2.0 controller. The following instructional blog shows the method for properly editing a MIDI file for Tesla coil use. Eastern Voltage Research also has many sample MIDI files available for free download if you don't wish to edit your own. Our sample SD card download contains a number of popular and specially edited MIDI files. You can download this sample SD card on our MIDI 2.0 controller product page.

How to Edit Tesla Coil MIDI Files – Instructional Blog
https://www.easternvoltageresearch.com/tesla-coil-workshop/how-to-edit-tesla-coil-midi-files2/

MIDI Channel

MIDI files for the MIDI 2.0 controller shall be assigned to MIDI channel 1. All other channels will be ignored by the controller.

Polyphonic Playback

The MIDI 2.0 controller is designed to support polyphonic playback meaning that it can playback multiple notes at a time. For the best sound, we recommend limiting playback to two notes at a time. However, like everything else, experimenting is key here. Experiment and find out what sounds best for your particular Tesla coil system.

Maximum Number MIDI Files

We recommend a maximum number of MIDI files be limited to 32.

Adding MIDI Files

When adding MIDI files, simply upload a properly edited MIDI file to the SD card and also be sure to change the value of the next.txt file to 1.

Deleting MIDI Files

When deleting MIDI files, be sure to delete both the .mid and the .mid.map files for each MIDI song you delete. After you complete the deletion, be sure to change the value of the next.txt file to 1.

MIDI Editing

The following link provides an instructional blog on how to properly edit a MIDI file for Tesla coil use.

How to Edit Tesla Coil MIDI Files – Instructional Blog
https://www.easternvoltageresearch.com/tesla-coil-workshop/how-to-edit-tesla-coil-midi-files2/

Technical Support

Please contact the technical support department at Eastern Voltage Research using the email address below for any questions or technical issues you may have.

Technical Support Department
support@easternvoltageresearch.com